Editorial

THE proposal that Melbourne's TV stations be situated on the heights of Mount Dandenong seems a very good one. It is also fortunate for Melbourne that such a spot is available. It commands a vast area of almost flat country for many miles around.

It would be more appropriate to congratulate Victoria on its good luck, for those TV stations are sure to feed strong signals much further than Melbourne.

The whole of the Bay area, at least, including the Mornington Peninsular, and Geelong on the other side, should be served equally as well as the capital city. Further inland are many small towns which can be assured of good programs.

It is a pity that Sydney could not follow this example, and site its stations in the Blue Mountains.

These are further from the city than are the Dandenongs from Melbourne, but there is no doubt about the coverage they would make possible.

Kurrajong has been proved an excellent VHF site, remarkably effective even using low power tests.

The main advantage of Gore Hill is that signals should fill up the low ground around Manly and the Southern beaches more easily than would those from a mountain site. This may not be so evident in the 60-70 Mc region, but on the 200 Mc band "shadow" effects are much more pronounced.

The higher frequencies are likely to produce phase distortion effects over comparatively long distances which might be a point in favor of a local site. These could be more serious than mere signal attentuation over the extra distance, but it does seem a pity that we have not had a chance to find out.

Another point springs to mind when considering TV siting. Why not erect a single, very high mast upon which all the TV aerials would be mounted, instead of using separate and smaller masts for individual TV stations?

Height is extremely important for good coverage, and it is already established that a common transmitter site is necessary so that directional receiving aerials can be used.

A single mast would look better, operate more efficiently, and probably cost less on a unit basis. There should be no technical problems if erected in a TV centre from which all stations would operate. It isn't too late to consider this possibility. Some day we might wish we had.

John Moyle

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RADIO
TELEVISION & HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION, HOBBIES AND POPULAR SCIENCE

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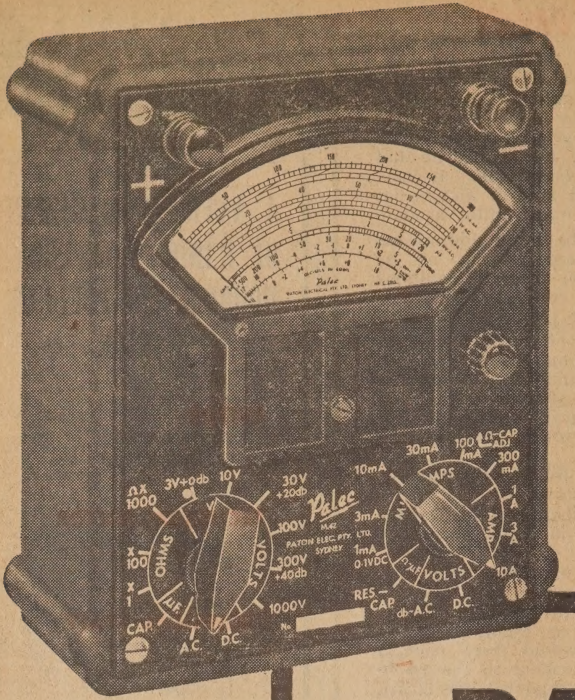
OUR COVER PICTURE

Shades of things to come An eager youngster eyes a special TV demonstration tube on display at the recent Chemical Industries Exposition in the Sydney Town Hall.



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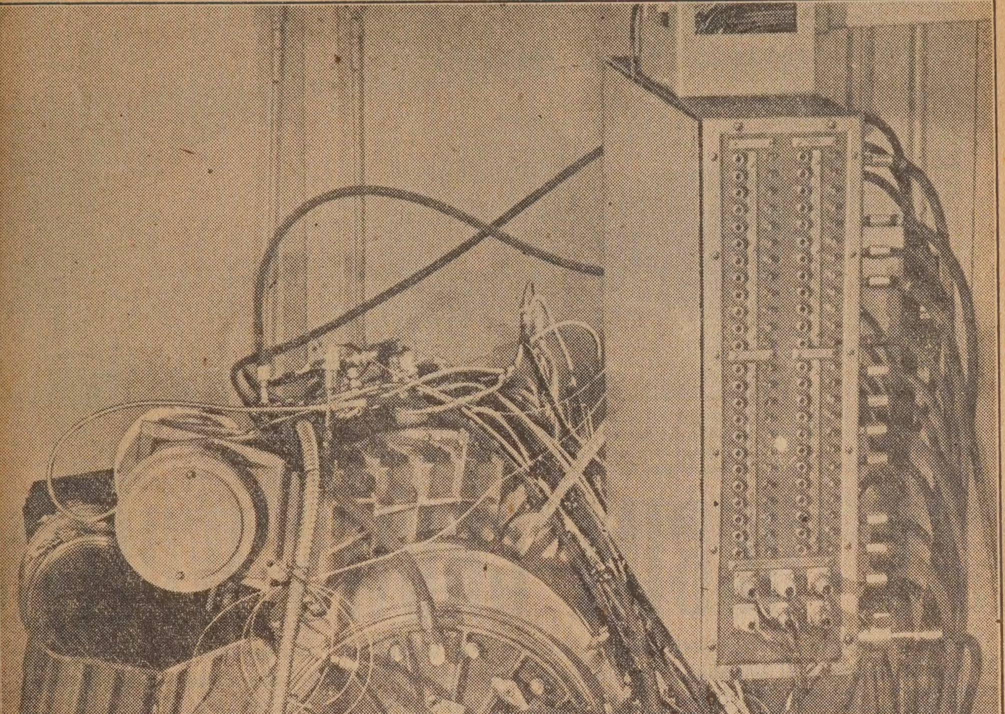
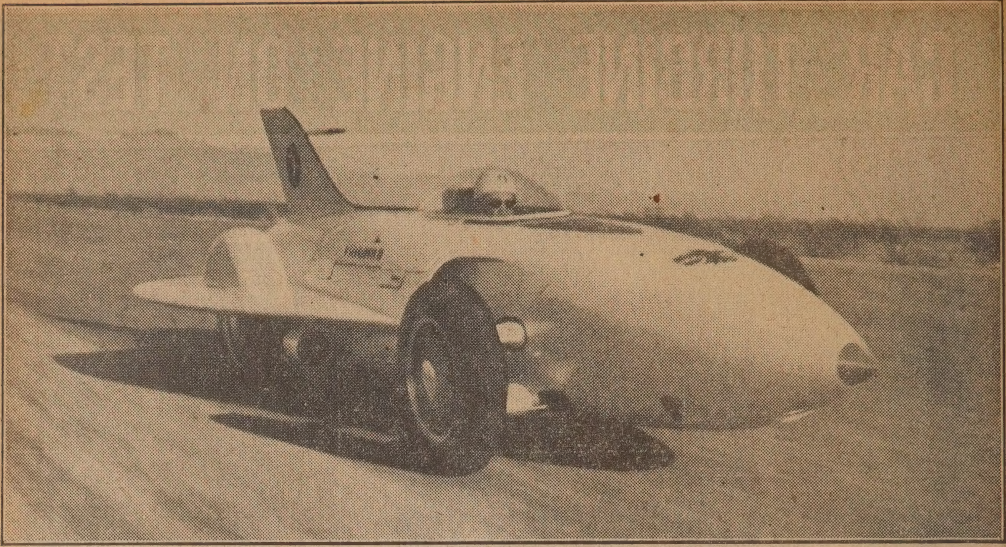
CAR TURBINE ENGINE ON TEST



An experimental gas-turbine engine shown on test at the Ford Research Engineering Centre in Dearborn, Michigan, USA. It is a "regenerative free-turbine" type power plant. The maze of wire leads from the engine to the recording instruments allow a constant performance check. It will be some years before engines like this will become available even overseas.



With Test Driver Mauri Rose in a plastic covered cockpit, General Motors' XP-21 Firebird skims over a test track at the GM Desert Proving Ground near Phoenix, Arizona. First gas turbine automobile in the United States, the Firebird has unique aircraft styling with a vertical tail fin and swept-back delta wings on its glass fibre-plastic body. The car was built to test the gas turbine's possibilities for ground vehicles and characteristics of aerodynamic design.

GAS TURBINE GROWS WHEELS

Behind the scenes in the automobile industry the battle for new power plants is raging. Greater power and unbelievable simplicity are promised by the gas turbine engine—descendant of designs which were born in the aircraft industry. Not yet, but some day, cars like those described may whine over our roads, and relegate the piston engine into history.

HERE in the smoky, whirling centre of the world's auto industry, the jet-turbine engine is red hot news. Once the sizzling star of the sky. It is now rapidly coming down to earth. Years will elapse before you and I will sit behind such an engine, but it is destined some day to effect drastic changes in the motor world.

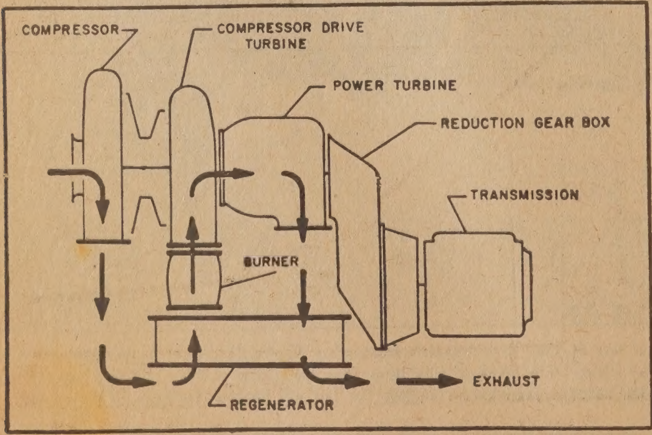
Detroit is famous for its unusual cars, but none are more revolutionary than the experimental turbine cars which daily glide through the city, undergoing rigid traffic tests. No one keeps their existence a secret any longer, for only an unusually keen-eyed observer can distinguish the turbine cars from current production models.

Tell-tale marks are few. There are the combined bumper and exhaust of the Plymouth or the flare airscoop of the Chrysler, whic alone pick out the revolutionar car from the other ordinary looking autos on the streets. But turbine cars carry one distinctive trai —a high pitched whine, somethin like the rustle of a sharp win through tree leaves — which tell the pedestrians that another je car is out on test.

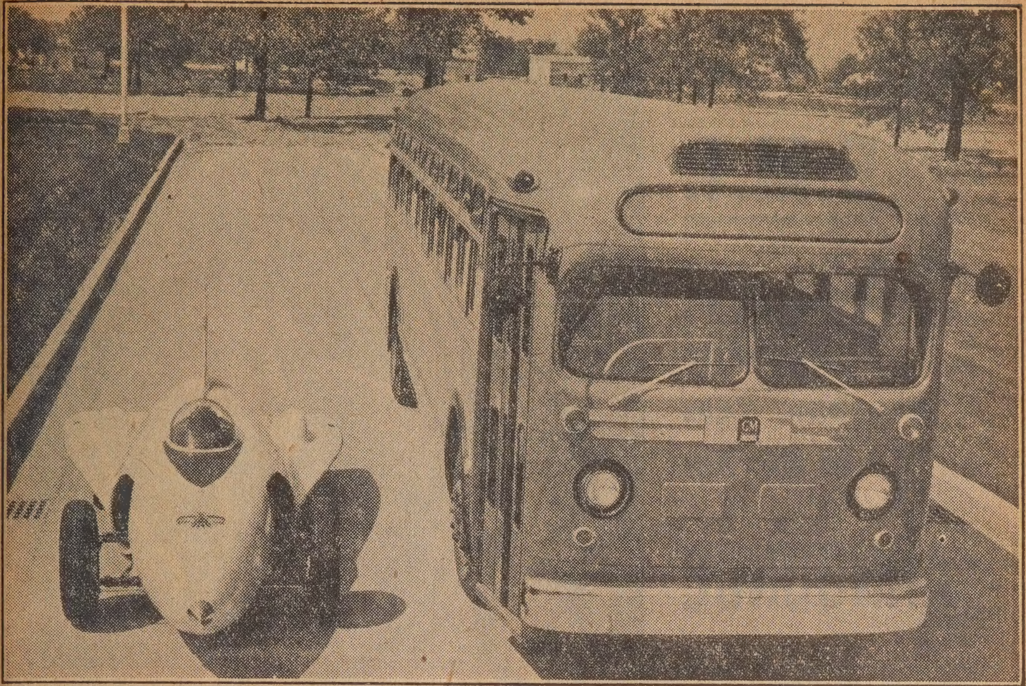
by Pedr

Davis

These revolutionary cars ar therefore shrouded neither in mystery nor secrecy. The 1955 Plymout turbine — the most advanced specimen in local captivity — has the tw words "TURBINE SPECIAL proudly chromed on its door panels while GM and Studebaker-Packar



Flow diagram of a gas turbine power plant, regenerative free-turbine type.



A General Motors' Turbine Bus together with their XP-21 Firebird testing car. This picture illustrates the wide range of size and power of which the new design is capable.

are surprisingly frank to inquisitive journalists. Only their very latest developments are locked in burglar-proof cabinets.

Fords, too, willingly hand out details of their progress in this field.

DOWN TO EARTH

Of course, it is high time that the jet came down from its aeronautical heights. It is now over 25 years since Frank Whittle took out patent rights on his jet-engine ideas. It is even longer — 50 years — since turbines were first put into commercial use, for producing electrical power, and they in turn are merely an adaptation of the old water mill, where fast flowing streams were harnessed to turn wheels for grinding grain.

Whittle was not the inventor of the turbine, but he did see for the first time that it could be effectively used to power aircraft. He was in his young teens at the time and had witnessed an experiment where a French scientist made a rocket sail through the air, generating its own gas, thus being able to stay in the air for a considerable time. Sir A. V. Roe, also saw the experiment at the same time and predicted that future aircraft would be powered in a similar manner.

IN GERMANY

Meanwhile, in Germany, other talented engineers were investigating the potential of the gas turbine engine. Both Heinkel and Junkers had experimental models on the drafting boards. But they dawdled happily along oblivious of the fact that the new power unit was to turn the tide of German aggression eight years later.

In 1937, Frank Whittle invited Air Force officials to visit his scant workshop. For a full 20 minutes they witnessed a jet engine straining forward on its bench mountings as smoke and flame belched forth from its business end. The thrust gauges told their own story—and the officials listened. At the conclusion of the experiment, they spoke again, "Go ahead. The Air Ministry is behind you."

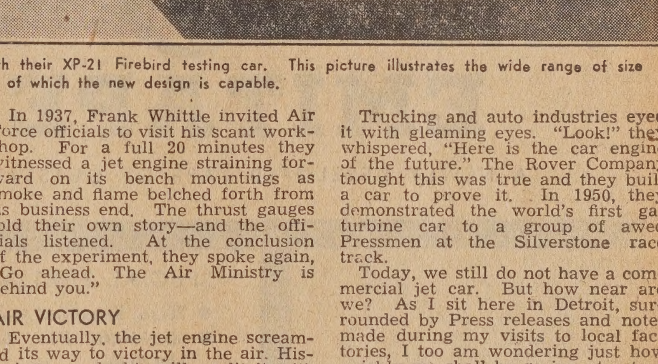
AIR VICTORY

Eventually, the jet engine screamed its way to victory in the air. Historians, no doubt, will credit it with materially shortening the war by many years. Whittle was awarded £100,000 sterling for his work, and other men also began to look to the jet-engine as a source of profit, commercial profit.

Trucking and auto industries eyed it with gleaming eyes. "Look!" they whispered, "Here is the car engine of the future." The Rover Company thought this was true and they built a car to prove it. In 1950, they demonstrated the world's first gas turbine car to a group of awed Pressmen at the Silverstone race track.

Today, we still do not have a commercial jet car. But how near are we? As I sit here in Detroit, surrounded by Press releases and notes made during my visits to local factories, I too am wondering just how quickly we shall be gazing at a turbine car in the show room.

It is hard to give an accurate answer. Some experts say five years, others less optimistic put the figure at fifteen years. But we do know that GT day is very close. When



Graph showing the drive-shaft torque of the gas turbine power plant.

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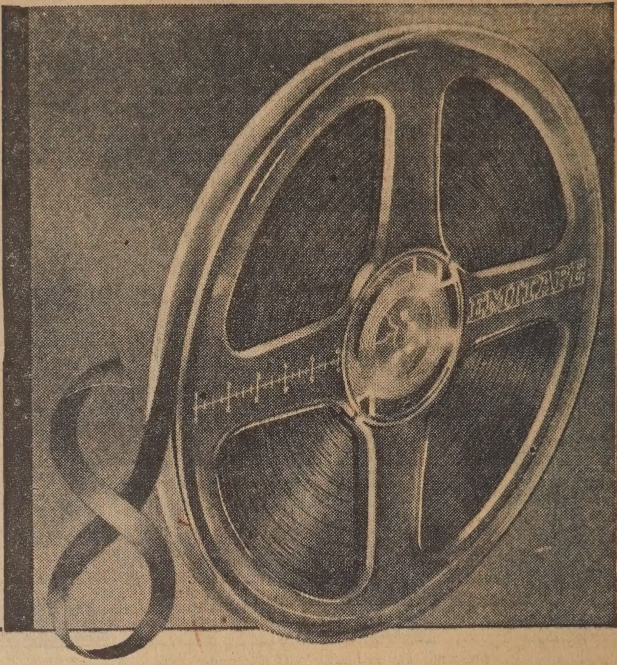

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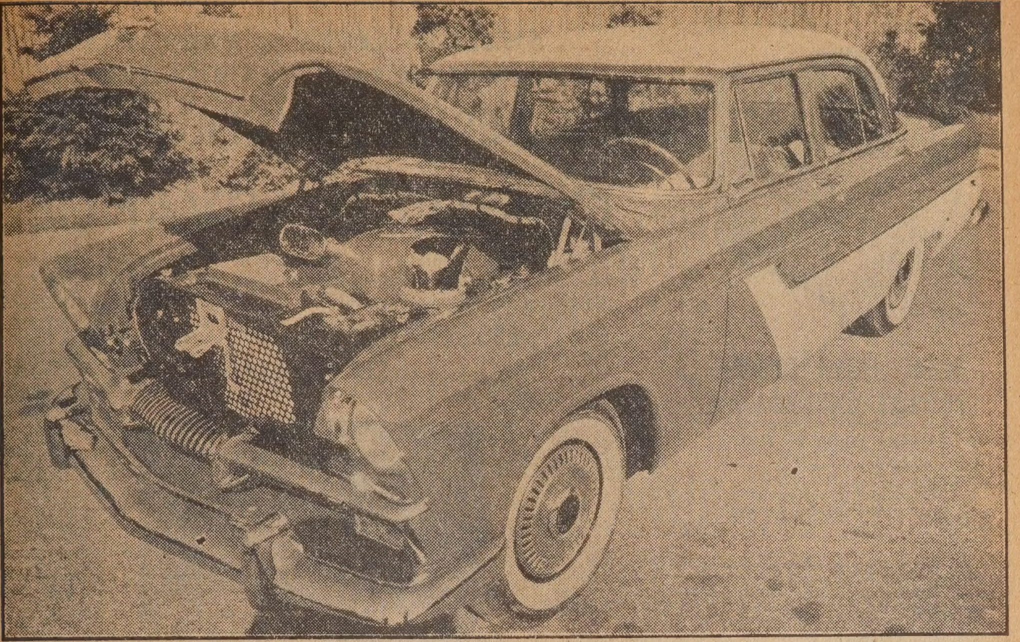


An experimental Plymouth sedan fitted with a gas turbine engine.

Fords, General Motors and Chrysler start a race to produce something, you can be certain that the race will develop into a sprint. Listen to what George J. Huebner, Chryslers' executive engineer, has to say:

"The fact that we are already operating a turbine car in downtown traffic might lead one to believe it is closer to production than it actually is. We could probably build a marketable turbine today—but it would be . . . fantastically expensive. . . . However, we at Chryslers are mighty enthusiastic about this project."

Ford's, too, are no less optimistic. Their Dr. Andrew A. Kucher says, "'All of us at Fords who are intimate with the turbine project have become increasingly convinced that the turbine will eventually supplant the piston engine in passenger cars."

At first, the designers of auto-size gas turbine engines found they were faced with some very thorny problems. Heat, metallurgy, speed and cost made them reach for their migraine tablets, but today many of the problems have been licked, those that haven't are battling against tremendous money and resources. They cannot last out much longer.

THE GASIFIER

Modern auto turbine engines, like the GM Whirlfire, are divided into two mechanically independent parts, the gasifier section and the power section, connected by a flexible duct. The gasifier section consists of a centrifugal compressor, twin combustion chambers and a single stage turbine.

The function of the gasifier section is to produce a source of hot compressed gas. In many ways it resembles a small jet engine. Air entering the unit is compressed to about three and a half times atmospheric pressure by the compressor. It is then forced into the two combustion chambers, where kerosene is sprayed into the air. After a spark has ignited the mixture, burning is continuous as long as the engine is running.

The starter mechanism is similar to that of a car. It must "rev-up" the compressor and gasifier turbine to 3000 rpm before the mixture is fired. Once it is running, the engine idles at about 8000 rpm, while the gas-outlet temperature is approximately 1500 degrees Fahrenheit before it enters the heat changer.

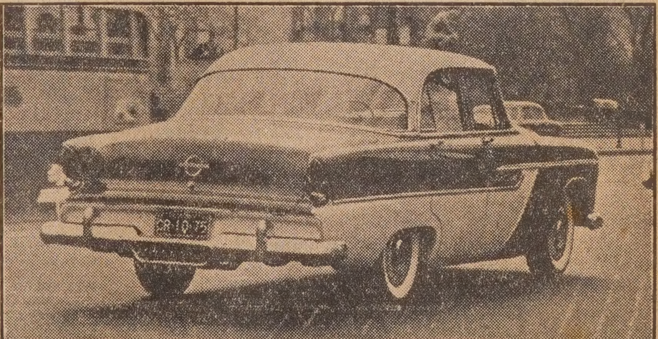
After the mixture in the combustion chambers has burned, the hot gases enter a nozzle ring, where they are accelerated and directed against the curved blads of the gasifier turbine wheel. The power required to drive this turbine wheel reduces both the temperature and pressure of the gases.

The exhaust gases from this operation, then pass through a flexible duct into the second section of the unit, the power section. The first turbine wheel is necessary to drive the compressor.

In the power section, the hot gases drive a second turbine, the power turbine. This is the turbine which drives the transmission gears and final driving gears of the unit. The transmission gears are necessary to provide "reverse" and "low" gear, should the latter be required.

The very nature of a turbine engine makes it easier to build a powerful than a less powerful unit. A 500 BHP engine would be a much simpler proposition than a 50 BHP unit for scale effects and reduced clearance become tricky on the smaller size, as the operating temperatures are identical for both units.

The "Whirlfire" engines, describ-



A rear view of the Plymouth showing the exhaust duct in the centre of the rear bumper bar. The test car is used in normal driving around the streets of Detroit.

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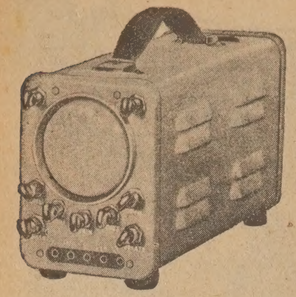

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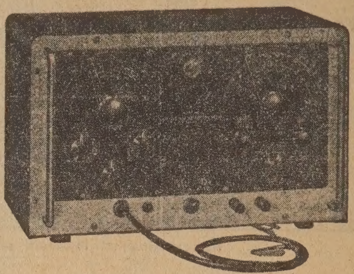

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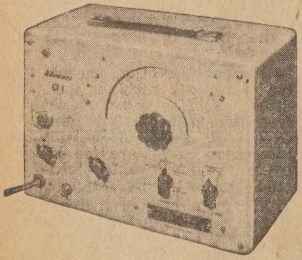

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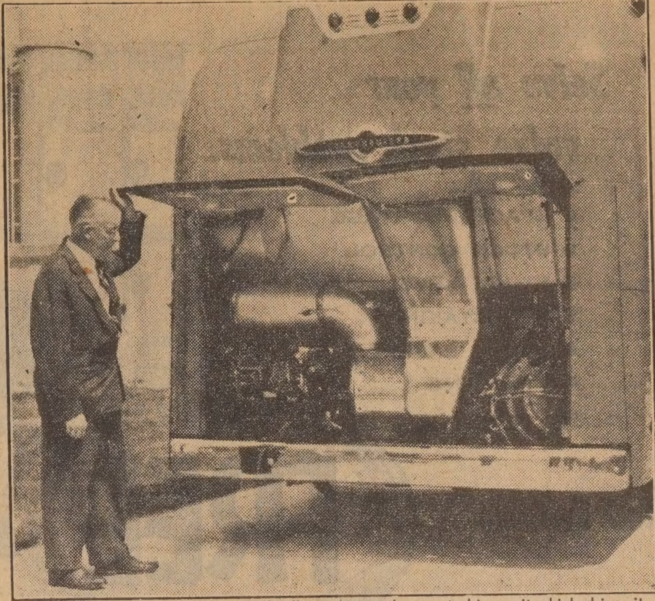
A TURBINE THAT DRIVES A BUS



Lifting two panels at the rear of the 'bus exposes the gas turbine unit which drives it.

above, develops 370 BHP when e gasifier turbine is spinning at ,000 rpm and the power turbine 13,300. Total weight of the unit 775 lbs—a very formidable weight first sight.

For those who like to think in rms of high speed, here is one fact chew over. The tips of the com- essor blades travel at a speed in cess of the speed of sound. They ceed 1000 mph!

General Motors have admitted at one problem which they have t to lick is the question of fuel onomy. Their turbine still requires vice as much fuel as a conventional gine. Chryslers engineers however ave cracked a very neat trick with eir new engine. Last year, they ere obtaining 14.9 mpg from the lymouth Belverdere turbine. This ear, they're keeping quiet—rumour as it that their turbine car now goes rther to the gallon than its piston- acking brother.

HEAT EXCHANGER

Secret to fuel economy on a tur- ine engine is the heat exchanger, ometimes called a regenerator. In act, without a heat exchanger, a urbine engine would be almost im- ractical from a fuel economy point f view. To obtain reasonable thermal fficiency from the the air taken nto the combustion chamber, it must e heated to about 1,200 to, 1,600 de- rees Fahrenheit. To achieve this in- ense heat, a tremendous amount of uel would normally be required and fficiency would be low because the xhaust gases are still extremely ot.

It is therefore necessary to heat he air before it enters the com- ustion chamber. The best way to do his is to use the excessive heat from he exhaust. The heat exchanger— r regenerator—is a device to take are of this pre-heating.

An extremely effective heat ex- hanger is known to be operating on he Chrysler turbine in the Plymouth Belverdere. It not only heats the ir sucked in from the atmosphere ut also cools the exhaust gases to reasonably low temperature before hey pass through the exhaust tube. t is known that at idling speeds (about 8,000 rpm) it is possible to old one's hand against the exhaust without being burned.

FORD ENGINE

Fords, too, are striving after good economy by making effective use of the heat exchange principle. Their regenerator is the newest on the market, though it has yet to be fitted to a roadable vehicle. The heart of their heat exchanger is a porous metal disc which resembles a honeycomb. It is only three inches thick but 22 inches in diameter. The reason for this odd dimension is to make the unit easily adaptable for conventional shaped engine compartments.

The disc rotates, absorbing heat from the exhaust gases which is then used to preheat incoming air. The big advantage of the rotary type unit is that extreme compactness is obtained, whereas the bulk of other types have caused some concern.

With the engine idling, the Ford heat exchanger will record 83 pc of the maximum possible energy from the exhaust gas — possible only because 9lb of air per second pass through the rotating disc, when the engine is under full power.

Another problem which once seemed more formidable than it proved in practice has been metallurgy. Engineers once feared that a turbine engine small enough for automotive use would not be practical unless expensive, special alloys were employed. Two years hard work on GT metallurgy has now convinced engineers that inexpensive materials capable of withstanding the high temperatures of a gas turbine, can be developed.

This is the biggest single reason for believing that a production model gas turbine car is nearer to the showrooms than is generally believed. Early GT prototypes were made from fully machined components, a most expensive method, as casting of special alloys was not practical.

However, the new General Motors engine shows the remarkable advances which have been made in this field. The turbine buckets (weighing 2oz each) have been precision cast by the "lost wax investment" process. from a new super-temperature alloy. The strength of each bucket can be realised, when it is known that each one must develop more than 6 BHP!

FURTHER PROBLEMS

There are still a few more problems—noise, braking and cost to be overcome—but progress is now so fast that you can almost put your name down for a turbine model now. Consider these advantages:

- Light, small engine permits radical new styling design of turbine cars.
- Engine has few moving parts, those no bigger than 8in diameter; no transmission gears except reverse; burns almost any low grade fuel.
- Riding will be smoother and quieter than today's supersmooth cars.
- Low cost operating and maintenance. Easier on your pocket and easier on the mechanic.
- No cooling system, hence no radiator. Simplified electrical system. Never need to change your spark plugs.

Sounds wonderful, doesn't it? But before you polish up your old model to make a quick sale, consider also these disadvantages:

- Braking systems on a gas turbine car are far from adequate. The engine slows down very slowly, consequently it hinders retardation not helps it. Jet cars are made to go — but so far they're not very good at stopping.
- Experimental engines cost £10,000 each to build. What your gas turbine car will cost, nobody knows —yet.
- Gyroscopic effects may be present from spinning engine. G.M. have eliminated this disadvantage to a certain extent by revolving gasifier turbine and power turbine in opposition direction.
- Slower starting than you're used to. Engine must spin for five seconds before it fires. Your cars takes less than five seconds —or does it?
- Can you afford an airconditioning set as well as a turbine engine? They run hot—1500 degrees. Noisy too, though sound proofing the engine compartments helps very considerably. Will eventually eliminate noise altogether.
- Initial acceleration is slow though higher speed range is almost unlimited.

These are all some of the disadvantages of running a jet engine across the ground not the wide open blue. But the turbine has come down from the sky. It has landed on earth for good. It can't be long now!

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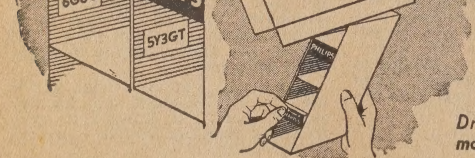

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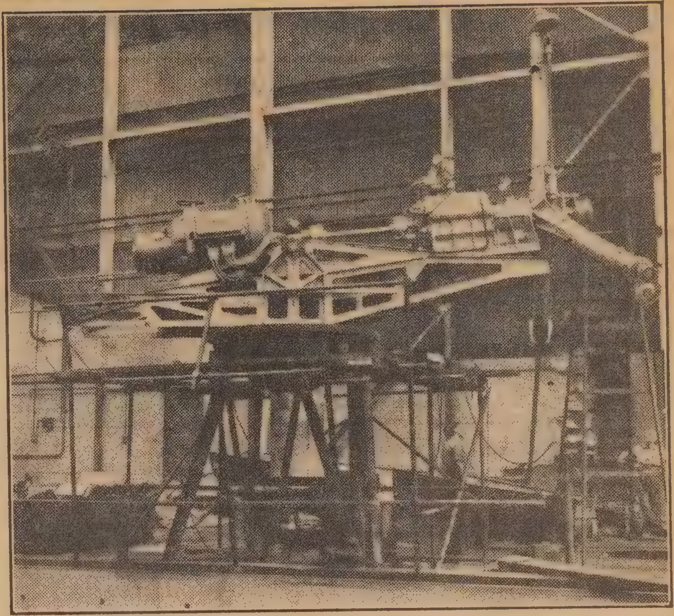
NEW LOOK IN WIND GENERATORS

Several types of wind-driven generators have been developed overseas within the last few years capable of remarkable results. Here are details of a direct-drive type with an output of of 100 Kw.

By RONALD CHALLIS



Trial erection of the windmill machinery for the 100 kW wind-powered electric generator constructed at Costa Head by John Brown & Company. Clearly seen are the generator, the gear box and the mounts for the automatic, variable-pitch blades.

WHILE the pioneers of atomic power have stolen the head lines, there has always been a special stirring of the blood set aside for the sort of pioneers who scale heights and face the elements.

So although its 100-kilowatt output is almost laughable beside the many thousands of kilowatts to be produced by atomic reactors, a windmill recently completed off the north coast of Scotland is in some ways a more thrilling achievement than anything the atom experts have evolved.

Standing on its 80ft tower in the raging gales that hurtle across Costa Head on Orkney Island, it is the most powerful generator windmill in the world, and is already feeding current into the Scottish national grid.

Not only does the Costa Head project ensure a place for wind-driven generators in the great race for electrical power, but it proves that the old-fashioned pioneer still has his place in a scientific world.

For four years the wind that was to drive the mill did its best to hinder the engineers. They dressed against Arctic conditions in Arctic clothing.

Their fingers froze as they manipulated delicate mechanisms; their eyes filled with stinging tears if they so much as glanced into the wind; their ears ached with cold. And at every moment they ran the risk of being blown from their perch on the tower by fierce gusts.

The 100 kW wind-powered electric generator showing the control house at the foot of the tower. This picture gives some idea of the conditions under which the engineers were forced to work.

Conversation while on the job was scarcely possible, and, to make their isolation complete, thick mist often reduced visibility to a few feet.

The weather did its worst in January, 1952, when a tremendous gale smashed wood buildings, uprooted heavy trees, shredded wild-fowl against fences and broke a wind-speed indicator that registered up to 125 mph.

In those conditions five men, led by Tom Mensforth, engineer consultant to John Brown and Co. Ltd., lived and worked for long stretches of time. It was, indeed, the lucky chance of having a small band of engineering experts in that wild and poorly-populated region that gave one of them, a local crofter named Billy Saviston, his entree into engineering.

What those men achieved by their four-year effort was a windmill of less visual charm than the inefficient specimens that used to grind corn in a domestic countryside, but at the same time a triumph of automation.

The actual apparatus consists of three blades of laminated wood with a swept diameter of 50ft. Like helicopter rotors these are hinged to yield slightly to the stress of wind pressure so that they avoid material fatigue.

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Output level: −55 db ref. 1 volt/dyne/cm^2.
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Weight—6ozs. unpacked, 7 ozs. packed.
Dimensions—microphone only 2¼in x 2⅜in x ⅞in.

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MIC 22

This omni-directional Microphone is robust in construction, with a pleasing appearance. Vibration, shock or low frequency wind noise will not affect the performance. The low frequency cut-off is dependent on the load resistance. The cut-off is given by the quotation, F = 80 divided by R, where F = c.p.s., R = megohms. An adaptor (floor mounting) is available at low extra cost.

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Output level = −50 db ref. 1 volt/dyne/cm^2.
Output impedance—equivalent to approximately 0.002 uF (0.8 megohm at 100 cycles).
Frequency response—substantially flat from 40 to 6000 c.p.s.
Recommended load resistance—not less than 1 megohm, dependent on low frequency response.

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MIC 28

Designed to give freedom of movement, this Microphone is small and non-directional. Housed in a soft moulded rubber case, which gives protection against shock, it is provided with a pin at the rear of the case for pinning to the lapel.

Output level—approx. −55 db ref. 1 volt/dyne/cm^2.
Recommended load resistance—5 megohms.
Frequency response—level throughout the whole of the audible spectrum.
Capacity—0.0015 uF. at 1000 c.p.s.
Impedance—100,000 ohms at 1000 c.p.s.
Cord—6ft. shielded cable.
Size—1-9/16in wide x 2¼in long x 5/8in thick.

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HAND or DESK MICROPHONE

MIC 33

This Microphone has been designed for the high quality public address and home recording field. High sensitivity and flat characteristics are obtained by a specially designed acoustic filter. Housed in an attractive plastic case with an unexcelled response for its size and price. Unaffected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7000 c.p.s.

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CRYSTAL MICROPHONE INSERTS

MICROPHONE INSERTS

(MIC 32 illustrated)

These inserts are available in varying sizes ranging from as small as 15/16in square to 1-13/16in round, with various thicknesses from 7/32in to 9/16in. Suitable for every purpose such as hearing aids, public address, tape recording, amateur broadcasting, etc., they have responses from 2250 c.p.s. to 3500 c.p.s. at 5 db to 30 db. Insert can be supplied with or without 10 meg. resistor as required.

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MICROPHONE INSERTS

(MIC 23 illustrated)

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They are also fitted with hydraulic buffers so that their turning causes only a minimum of vibration. This problem was originally so acute that the project was almost anbandoned.

The versatility of the blades alone is surprising for, just as a bird adjusts the angle of its wings according to its air-speed, so the blades on the Costa Head mill can automatically "feather" themselves so that they never rotate above a certain speed.

The generator plant is lodged in a nacelle, which can turn bodily with the wind.

But the odd thing about this windmill is that it turns its back on the wind; this ensures that the blades do not touch the tower as they yield to high wind pressure.

COMPLETELY AUTOMATIC

Although an operator can control the mill by press button, it is intended to run without human interference. As the wind gets up, the machine takes itself through a complicated routine.

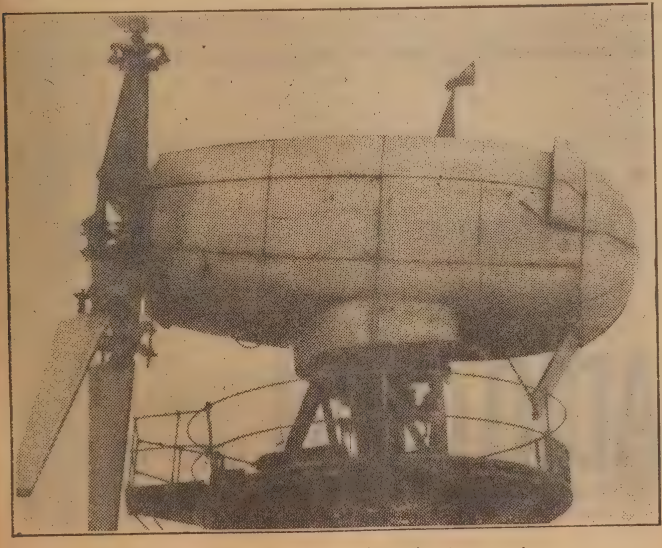
- A small pilot windmill tots up the average windspeed over several minutes and gradually generates a voltage proportional to the force of the wind. As the wind reaches 23 mph the electricity generated becomes sufficient to switch on the entire automatic control.
- This means that pumps begin to deliver oil into lubrication and hydraulic plants.
- It is then safe for the governor to take control of the main rotors, which are consequently freed and turn faster and faster till they reach the maximum speed allowed by the governor.
- At this point an automatic clutch gears the main shaft to the generator, stepping up the revolutions from 130 a minute to 750. The mill is then producing electrical power.

By the "feathering" of the blades the apparatus runs at roughly constant speeds no matter how strong the wind may be. And below a given windspeed the procedure for stopping is equally automatic.

REMOTE CONTROL OF CRANE

At the site of the new UNESCO Building at The Place Fontenoy, Paris, can be seen this tele-guided crane which is being used for the first time in France. The operator controls the crane by pressing the appropriate buttons on his control panel. An electric motor supplies the power. UNESCO's 7-storey building, housing 1000 employees, is due for completion early in 1957.

The particular value of this type of generator, as Tom Mensforth pointed out, is that "the conception of waste simply does not apply to wind power".



Close-up view of the nacelle of the electric generator.

On an experimental project such as that at Costa Head it is impossible to give any useful estimate of the cost involved in production. But the firm is sufficiently pleased with the economics of the idea to have gone ahead with plans for a 250 kilowatt mill.

It will benefit from the mistakes of that at Costa Head. By having two blades instead of three it will operate just as efficiently, but cause less vibration. Research is going on to find a suitable metal alloy to replace the expensive laminated wood used in the blades.

HIGHER POWERS

And they speak hopefully of windmills capable of 3000 kilowatts. There are 70 possible sites in Britain, they say, and a 3000 kilowatt wind-driven generator on each would contribute 2 pc of the power at present needed in Britain.

Considering that even the present 100 kilowatt midget at Costa Head can adequately supply a village or fair-sized factory, such a contribution could not be sneered at.

Australia is one of the many other nations in the world that could most suitably use this form of power. In some countries, indeed, the wind is virtually their only resource.

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SCIENCE NOTES BY PROF. A. M. LOW

The steam from a railway engine and the "Pepper's Ghost" effect provide a subject for discussion, this month. Then, for good measure, the writer reveals the secret behind the "blushing portrait."

SOMEONE asked me the other day how it was that when an express train comes down the line and a trail of steam comes from the safety valve, this white cloud seems to be cut off sharply at the last carriage.

In point of fact, steam is invisible. The white cloud is chiefly tiny particles of moisture and when it reaches the rear of the train, where there is a slight vacuum, the pressure is reduced and the water particles evaporate again into invisible steam before they are totally dispersed.

Small drops of water are very interesting. The pressure in a tiny drop may easily reach 20lb per sq inch or more, because of the surface tension of the "electrical particles" in the mosaic from which all matter is constructed.

ATOM-BOMB!

It is rather imaginary, but one might almost say that it is the release of these vast forces which gives the atom-bomb its power.

Small drops may be made to coagulate if they are electrified. Sir Oliver Lodge made some interesting tests in this way, having as their ultimate object the dispersal of fog.

I wish such a plan could be applied to places like London but, until we can obtain electrical energy more cheaply, the expense would be far too great on any worth-while scale.

Many experiments have been made to produce rainstorms or their equivalent dispersal by dropping electrified particles of sand from aircraft or by firing vortex rings into the clouds. Here again it is a question of scale, for at present we have not the vast power available to interfere appreciably with nature.

Atomic energy might easily change this and one foresees the time when bitter complaints come from the Continent because England has secured fine weather at the expense of Juan les Pins.

Now let's change the subject.

VASELINE "GHOST"

There are many ways of producing "ghosts" effectively. One of the most amusing is to draw in Vaseline the picture of a skull on the back of your coat. Only a little Vaseline is necessary and it will easily clean off afterwards.

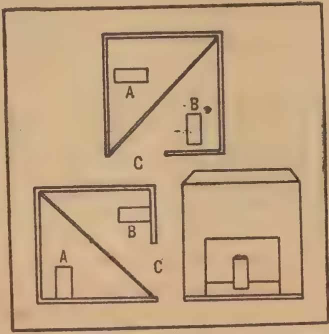
Now obtain a small "black-light" ultra-violet bulb, such as is used for sunshine treatment, only smaller. You can sit with your back to the lamp, turn out the lights in the room and get someone to put on the ultra-violet, which can be thoroughly screened so that its visible light is nil.

The Vaseline "ghost" glows brightly in a terrifying manner but, if someone switches on the ordinary room lighting, nothing is seen at all so, of course, there can be no trickery.

An interesting little apparatus can be made by a very much simpler plan on the style of the old-fashioned Pepper's Ghost.

To make it you require a box, say about 14in cube. In it place a sheet of glass across the box from the front of the edge to the back of the opposite edge diagonally.

Behind this glass place, for example, a vase of flowers (A) and have it lit by a bright light in the top of the box, the light being concealed so as not to be visible from the front.



Two versions of the well-known Pepper's Ghost. The top sketch is of a box divided diagonally, while underneath are two views of a box divided vertically. "C" is the space through which the audience views the objects inside.

In the other space, place the model of, shall we say, a doll (B) with a similar light concealed in the top of the box.

If this apparatus is placed at some distance from the audience, the inside of the box being painted dead black, you will see the flowers when the bulb over the flowers is on, but if you switch off this bulb and simultaneously put on the bulb over the doll in the other box, you will see a reflection of the doll from the 45deg diagonal glass.

The flowers were, of course, seen through this glass which does not show if lighting is carefully arranged.

There are many variations. If the box is stood on a table your friend can put his head up into one half, while the other contains a model of a donkey's nose and face.

Any simple combination of this kind will doubtless suggest itself to you in a moment and, if you like to be very technical, you can arrange a resistance so that, as one light dies out slowly, the other comes on with equal strength.

Now let me say something on the subject of this strange but now rare faculty of blushing.

I have a friend who has equipped his dining-room with an extraordinary picture. When someone tells an after-dinner story which is a little suggestive, he points to this oil painting of an old-fashioned and charming woman and says, "You are making my aunt blush."

The face is of a pale delicate cream, and it is a fine painting but, as his fascinated guests look up, a brilliant blush suffuses the aristocratic cheeks.

The method by which this is achieved is interesting. Among the oxides of mercury and other metals are several compounds which suffer what is known as temperature change. At varying temperatures the material changes colour.

TEMPERATURE GAUGE

This characteristic is used in practice for indicating temperature changes such as occur during the hardening of steel, when more accurate electrical methods are not available.

It is used in sealing some kinds of electric light bulbs, so that the operator can tell when the approximate temperature of the seal has been reached.

Mixed with the paint used in the aunt's picture is some of this substance and, behind the canvas is a small heater resistance such as one sees in the cigarette lighter of a motor-car. A button is touched under the table, the resistance becomes hot and on comes a blush of which any ingenue might be proud.

Do not confuse this temperature change with the alteration in crystalline form which takes place when certain salts of copper are wet or dry. It is these which are employed to give a rough indication of the amount of moisture in the atmosphere by impregnating, for example, the dress of a doll.

MORE POWERFUL ATOM SMASHER

A NEW 20 to 30-billion electron-volt machine has been planned by eight American mid-western universities. The ultimate aim is a hundred-fold increase in the beam intensity of a high-energy atom smasher, simpler construction and operation.

The inventor of the betatron type of atom smasher, Prof. Donald W. Kerst, of the University of Illinois, headed the design group that found that pulsed magnets requiring complex control and power equipment can be eliminated, saving much cost.

New designs for magnets that can control simultaneously low and high energy particles were worked out with the aid of electronic computers.

Several American universities and a State College hope to build the multi-billion-electron-volt machine with Federal funds. It would deliver five to six times the energy of any now operating. It would be equalled only by a machine planned for Brookhaven National Laboratory on Long Island, NY, and one being planned by European nations jointly at Geneva.

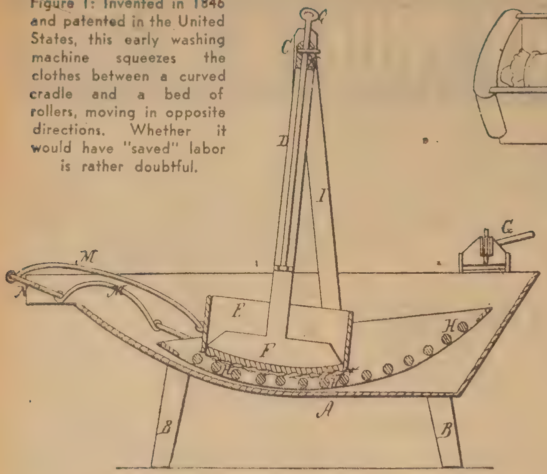


Figure 1: Invented in 1846 and patented in the United States, this early washing machine squeezes the clothes between a curved cradle and a bed of rollers, moving in opposite directions. Whether it would have "saved" labor is rather doubtful.

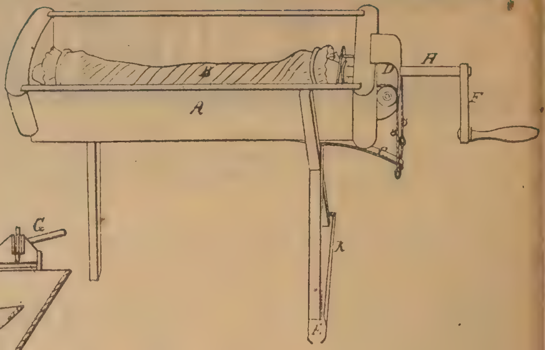


Figure 2: This clothes wringer, patented in 1847, imitated hand movements by squeezing the clothes in a slit sack. An earlier British version simply twisted the clothes themselves. Rubber rollers and centrifugal action had not been thought of.

LABOUR SAVING IS OLD STUFF

A study of the history of modern labor-saving devices reveals that there is indeed "nothing new under the sun". Vacuum cleaners, washing machines, spin dryers and a host of other devices all have their prototypes in early patents.

HOW often is it said, when a new gadget or machine makes its appearance on the market, "Isn't it simple? It's a wonder someone hasn't thought of it before."

It is a safe bet that somewhere in the distant past someone did think of it before or at least the fundamentals of it.

Perhaps it never came on the market because it was before its time. People must be ready for new ideas, you know. It is really an extremely difficult thing to impress the bulk of the human race with something new, even in these enlightened days.

Speaking for myself I had the dickens of a time trying to get my wife to want a washing machine. My insistence, I must admit was partly due to my desire to have the household chores cleaned up by the weekend to make more time for sport and relaxation. It didn't work out that way, though. Having bought a washing machine, we now have more time to do the garden and paint the house. I am now looking for an automatic gardener and house-painter.

Practically everything ever invented made its debut under a cloud of suspicion and, in many cases, it took so many years to get the thing on the market that the inventor became discouraged and gave it all away. Only to find, of course, that, before he died, someone else came along and made a fortune out of the same idea.

The machines we use in the household and industry today, in many cases, had very humble beginnings.

Take the washing machine for our first example. Do you recognise it in figure 1. This is a picture of a washing machine invented in 1846 and the subject of a United States patent.

It was a fearsome contraption de-

Figure 4: Based on a British street sweeper, patented in 1842, this revolving brush carpet sweeper is similar in principle to its modern counterpart.

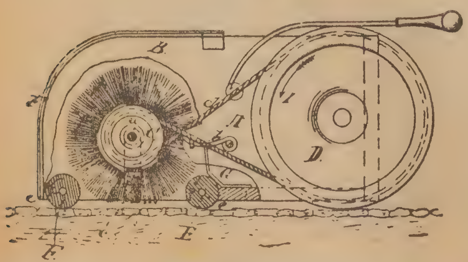
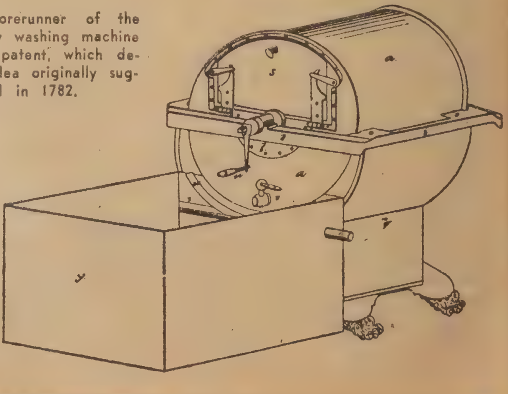


Figure 3: Forerunner of the modern rotary washing machine is this 1851 patent, which developed an idea originally suggested in 1782.



igned to imitate the to-and-fro movement of the human hand.

By means of a crank, the set of ollers and the cradle in which they were suspended were made to slide in opposite directions. The curved portion F squeezed the clothes between the rollers.

No doubt this machine made short work of the clothes and buttons, as well as the washing. It was more adaptable to crushing stone than washing clothes but, no doubt, quite a few were sold.

As early as 1691 a patent was taken out in England for a washing machine but this one of 1846 seems to be the first really practical idea put into production.

WASH BOARDS

These passed through various stages of development right through to 1927 when a patent was taken out for a similar device which replaced the rollers with two ordinary wash boards moving in opposite directions in a container of water. This was a tremendous affair which could best be accommodated in a specially built outhouse.

It was a little more gentle on the clothes but less so on the back of the operator, for a session of pushing a great lever back and forth for some time was more tiring than a normal wash day.

Having now set people to be washing machine minded it was a logical outcome to try and do away with the laborious wringing.

Like the basic idea of the washing machine described, this was thought out as early as 1780 in a British Patent No. 1269. This took the form of a trough over which are suspended two hooks. The clothes were fastened to the hooks and, by turning one of them only, the water was squeezed from the linen.

by Calvin Walters

This was improved upon in the USA in 1847 by providing a long bag into which the clothes were placed. This bag was suspended between the aforesaid hooks. By twisting the bag the pressure was exerted on the clothes and the water thus removed. This machine is shown in figure 2.

Methods such as this were the clumsy forerunners of the rubber rollers of the present day wringer or the spin drier in common use.

The idea of rotating clothes in a perforated drum immersed in a container of water originated from the British patent of 1782. This was further developed in 1851 by James King who built the machine illustrated in figure 3. From then on it was only a matter of improvement and the present day machine is just a little more refined while still using the basic idea.

Strange as it may seem, the carpet cleaner had its origin in the street sweeper invented by Joseph Whitworth in England in 1842. In point of fact, it is not very different in principle from the ones used at the present time.

It wasn't a very difficult thing to put the idea to work on a small scale for tearing carpets to shreds. A glance at a picture of the patent taken out in 1859 shows it in detail (diagram 4).

In different forms the idea was refined until today the basic idea is almost the same as in 1859.

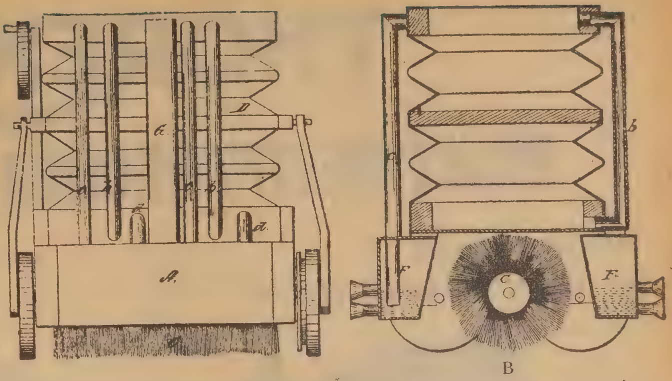


Figure 5: In this 1860 model carpet sweeper, bellows driven by the wheels suck up the dust from the brush, drawing it through water chambers.

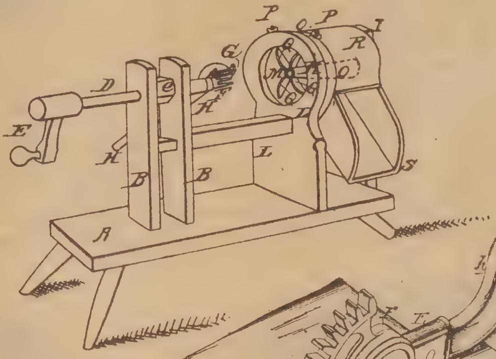


Figure 6: (Above). This machine patented in 1838, "simplifies" the job of peeling, coring and quartering apples. It might be popular in the home if apples weren't so expensive.

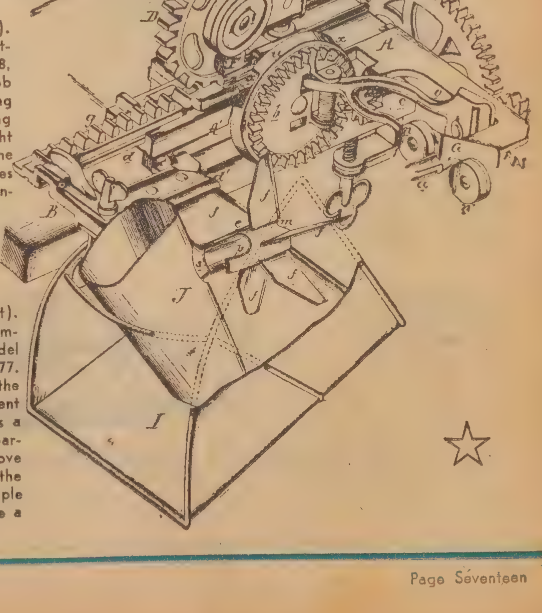


Figure 7: (Right). This is an "improved" model patented in 1877. It supports the apple to prevent breaking and has a "supplemental paring knife" to remove the skin near the stalk. Most people nowadays just use a sharp knife!

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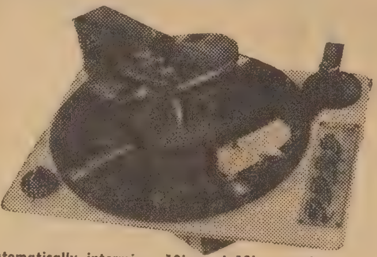

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  - ● through precision bearing: exclusive tone-arm lift mechanism allows a two-balls vertical pivot;
  - ● through new extra light auto-trip mechanism.

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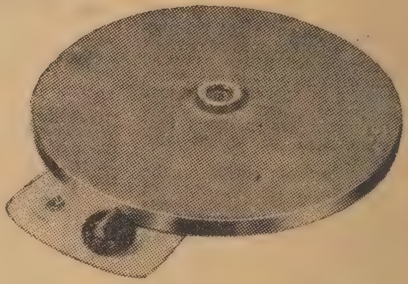

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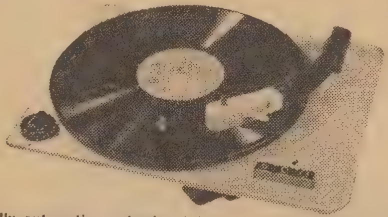

- ★ Fully automatic mechanism brings the pickup stylus swiftly into the first groove of the chosen record.
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- ★ Easy pickup tracking weight adjustment.
- ★ Balanced heavy 12in turntable for flywheel action.

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Athol M. Hill

Then in 1860 some bright fellow hought that it would be a good idea f the dirt could be sucked up into container after the brushes had tirred it up from the carpet.

This resulted in the machine picured in figure 5. In this case a pair f bellows is attached above the rushes. The dusty air is drawn hrough a water chamber. After se the resulting mud is emptied rom the container which is then efilled with water ready for another time.

The use of bellows was continued into the end of the 19th century until about 1900, when huge machines operated by hand were used by firms to go from house to house to do the cleaning.

These were too large to be taken into the house. They were set up outside on the street and pipes were led through the windows to clean the carpets whilst furniture was taken outside to be treated.

The owners of these machines got into trouble with the authorities. They were often fined for frightening cab horses in the street.

With the advent of the electric motor, efforts were made to make smaller portable machines. This was not before time because the abovementioned machines suffered from the disadvantage of requiring too many men to operate them. It usually required three robust fellows. One to turn the handle of the machine. The other two acted as removalists and cleaners.

In 1910 revolving suction fans were used in fixed installations. These fans were often turned by a water wheel connected to the household supply.

However, the first electric vacuum cleaner seems to have appeared in 1909 when the Hoover Company of America advertised extensively their new electric cleaner.

Today the vacuum cleaner is a vital necessity in any household but it differs little from the basic ideas formulated almost 100 years ago.

REFRIGERATORS

When you look at that beautiful refrigerator in your kitchen just think how difficult it must have been for people in early times to cool off the beer.

In 1805 ice was dug from glaciers and so on to be exported by George Washington to Martinique and other places. It was natural that, as time went by, busy minds would try and overcome this awkward situation, even though people in the tropics might find some historical comfort from the fact that their beer was cooled by ice from some million year old glacier over whose surface at one time roamed men and animals of the ancient ice age.

The problem was how to get ice more easily and cheaply. Michael Faraday was on the way to it only he didn't know it.

In 1823 he noticed that if ammonia was heated in a U shaped tube it recondensed in the other limb of the tube. When allowed to rest the ammonia would again evaporate and produce intense cold.

It wasn't until 1860 that the first successful ice making machine came to light.

This was the one devised by a Frenchman named Ferdinand Carre. He put it on show at the London Exhibition in 1862.

WASHING DISHES—1865 STYLE

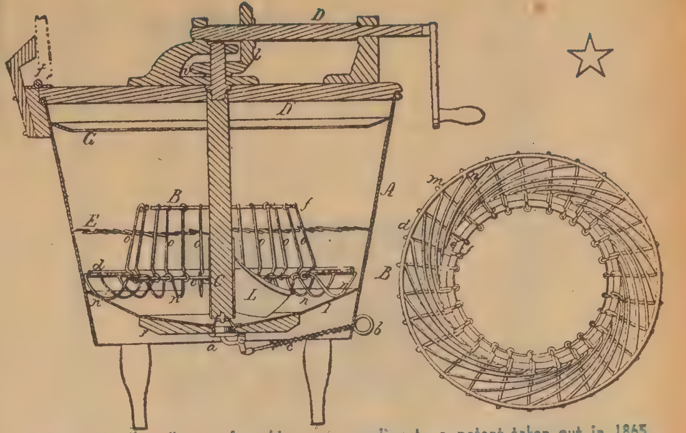


Figure 8: The "easy" way of washing up according to a patent taken out in 1865. Add an electric motor, however and it becomes essentially similar to the modern dish-washer.

It consisted of a boiler filled three parts full with ammonia and standing in a stove together with a cone shaped vessel immersed in cold water. The ammonia gas was liquefied by the surrounding water and, on volatilisation, it absorbed heat from the water in the smaller vessel thus causing it to freeze.

STILL IN USE

The trouble with this outfit was that the stove had to be continually stoked. This, together with its enormous size was rather a bother for any housewife although, in principle, the idea is still in use today in ice factories.

The Swedes came along with an automatic device which replaced the fire with a gas flame. This was a great improvement.

With the advent of the electric motor things took a tremendous leap. It was found that the refrigerant could be liquefied by pressure. This was provided by a compressor and a condenser.

Subsequent evaporation of the refrigerant inside the refrigerator produced the low temperature required.

The first electric refrigerator appeared in 1916. With subsequent developments some improvement took place until today the basic idea is still used and further developments seem to be only toward improving the appearance of the container housing the mechanism.

A glance through the patent files of the United States and England shows that when it comes to gadgets the people of over 100 years ago were by no means backward in their desire to save the labor associated with the household.

Look at the picture of the machine for paring and coring apples. This was the subject of a patent taken out in the USA in April, 1838 (Figure 6).

The apple was stuck on the fork at the crank end of the machine. While the crank was turned the operator guided a knife against the apple until it was peeled. By then forcing the apple into the opposite end of the gadget a four-bladed knife cored it and cut it into quarters.

SKILL REQUIRED

This works like a miniature lathe and it is only the skill of the operator which determines how much of the apple is left after paring.

Guiding the knife automatically came in 1869 while a fearsome affair was patented in 1877. A picture reproduced (Figure 7) here gives some idea of the fertile brain of the inventor. The machine looks something like the internals of the gearbox of a modern motor car.

This was really a precision instrument which had, in addition to the automatically fed paring knife, another one which removed the skin from around the stalk. Delicate guides held the apple in a velvet grip without breaking and it was delivered to the eater as a marvel of the apple-paring art.

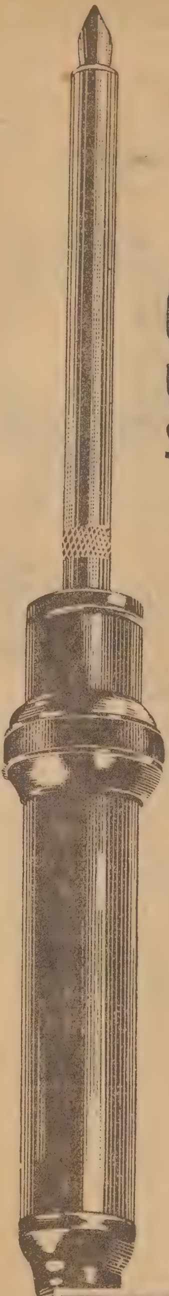
The apple-paring machines of today are not much different to these early ones and a great deal less complicated than the geared model illustrated which needed only a four-horse power motor to turn it into a motor-bike!

EGG-BEATERS

When the wife beats up the eggs for her cake with an egg-beater she is using a gadget which has shown no change since it was first invented in 1860. The only difference was that the 1860 model was provided with a curled stem with revolving blades at the bottom. The stem was provided with a knob which was pushed up and down the stem, thus causing it to revolve.

Today's hand-driven egg-beater is provided with a geared wheel which is turned with a handle but even this was first produced in the 1870's.

(Continued on Page 21)



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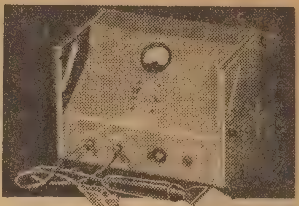

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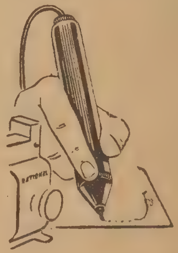

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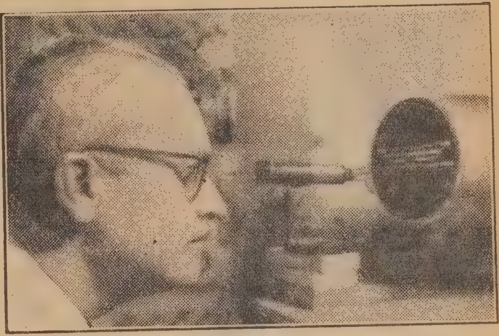
Vibroscope operates from Scope Iron Transformer or AC/DC sources between 3 and 4 volts. Retail Price 35/-.

N.Z. Distributor: H. W. Clarke, Auckland & Wellington. Manufactured by Scope Laboratories, Melbourne, Vic.

Technical Review

CAN TRANSLATE CODE AT 100,000 WORDS PER MINUTE

A new electron-image tube that can translate coded signals from tape, keyboard or radio into clearly defined letters and figures at speeds up to 100,000 words per minute for high-speed photographic recording has been announced by RCA.



The new RCA electron image tube that converts code to words and figures at high speed is adjusted by Warren H. Bliss at the David Sarnoff Research Centre.

THE new tube, developed at the David Sarnoff Research Centre of RCA Laboratories at Princeton, NJ, fills an acute need for high-speed printing devices operating directly from data in coded form.

When it achieves commercial form, its initial application is likely in electronic message transmission and computing systems. Further development is expected to fit it for wider application in general printing as an electronic means of typesetting.

In operation, the tube simulates typesetting in selecting letters and figures one by one from a "font" and placing them in luminous form on the 5in circular tube face either in lines or in any pattern desired.

MANY USES

The ability to place the characters where they are wanted gives the tube wide flexibility for such tasks as producing financial statements, balance sheets and bills, where letters and figures must be placed in various positions on a form.

The "font" from which characters are selected is a lantern slide bearing a chart of letters and figures which are projected from outside the tube on to a sensitive layer at the rear of the tube. Any of a variety of slides may be used, permitting selection from a wide range of type styles for reproduction on the tube face.

The new image tube is 25in long and resembles in appearance the cathode-ray tubes used in oscilloscopes. Its operation, however, is substantially different.

The layer at the rear on to which the slide is projected consists of photo-emissive material, which emits a stream of electrons in the pattern of the projected letters and figures. The electron stream, carrying all of this information, is accelerated forward in the tube by a voltage applied to the wall coating of the tube.

ONE AT A TIME

The selection of letters and figures in the required order is accomplished with a tiny aperture at the neck of the tube, permitting only one character at a time to pass through.

As the electron stream moves toward the aperture, a magnetic deflection coil around the outside of the tube shifts the stream so that the desired character passes through the aperture and speeds toward the tube face.

Another set of magnetic coils then focuses and deflects the character to its proper place on the face, where it appears in visible form on a phosphor screen like those used in television picture tubes.

As many as 4000 characters have been produced clearly in a single pattern on the 5in tube face. The second set of coils is capable, however, of varying the size of the letters and figures on the screen if enlargements are required.

The entire process of selecting the character, passing it through the aperture and placing it in the right location on the tube face can take place at speeds up to 10,000 letters a second, depending upon the rate at which coded information is fed into the circuits controlling the tube.

The source of the coded information can be perforated paper tape, magnetic tape, wire or radio signals, keyboard selection, or an electronic storage unit such as a magnetic memory.

In tests of the tube at the RCA Laboratories, the source has been a perforated tape like those used in teleprinter circuits. In any case, the coded input can control both the selection of the characters and their location on the face of the tube.

LABOR SAVING IS OLD STUFF

(Continued from Page 19)

The modern changes are merely the provision of an electric motor to do the turning. If they had motors in the early days their egg-beaters would have been the same as ours.

Dish-washing machines were used as easly as 1865 but if you count the wife in, then, of course, they were used since the dawn of time!

The modern version is a drum containing a system of wire racks. The rack revolves while water is thrown through the crockery supported by the racks. The rack, of course, is revolved by an electric motor.

Now look at the picture of the machine of 1865 (Figure 8). There is little difference. Of course, the machine had to be turned by a hand crank which made the job a bit arduous. In fact, with the machine full of heavy crockery it is doubtful if one would have not found it easier to wash up in the usual way. But, of course, only the wealthy could afford a machine in those days and the hard "yacker" was done by a maid at about fourpence a week and keep with every fifty-third Sunday off.

It will thus be seen that throughout the centuries man has devoted his time in trying to find other ways of doing his work without working.

This tendency exists even to the present day but it is doubtful if it is getting him anywhere for he finds that all the modern adaptations of the old fundamental principles described above are so expensive that he has to work harder than ever in order to get the money to pay the instalments.

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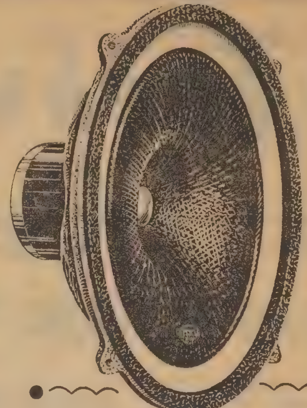

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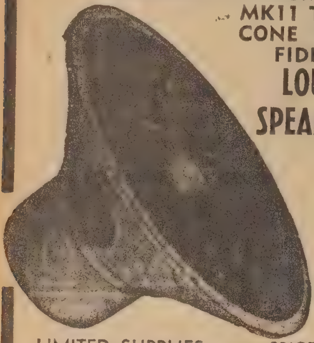

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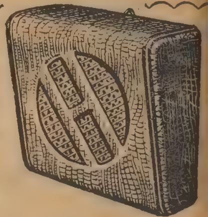

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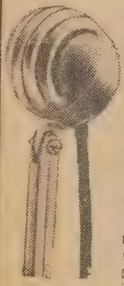

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(Illustrated at left)

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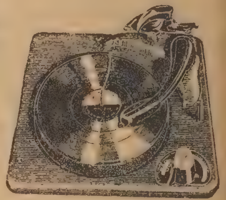

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INDUCTION FIELD GIVES TRUE "WIRELESS" RECEPTION

An article in Radio Electronics gives further details of the British "Stethophone" system, recently referred to in our News and Views columns. By this system, a person wearing light earphones can listen to a radio program without disturbing anybody else and without being hampered by trailing wires.

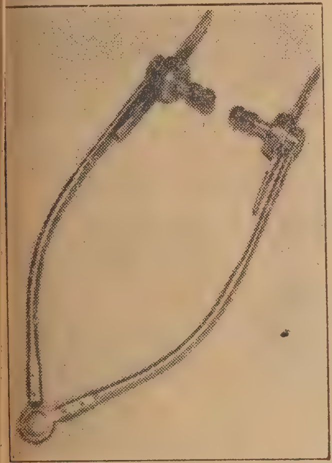
The Stethophones in the normal listening position.

THE system invented by V. A. Foot has recently been installed in ome British hospitals and in the front benches of the House of Commons (England).

It is also being considered for use n places such as clubs, where some want to listen to radio while others desire to talk, read or play cards. Only those wearing the proper earpieces can hear the sounds that they e-produce.

The system is known as the "Stethophone". The name is self-explano-ory, for the wishbone-shaped earphones resemble doctor's stethoscope.

Each set of phones is a completely separate unit with no external connections.



A close-up of the Stethophones. Note the knurled knobs which control the voulme in each earpiece.

Around the walls of the room runs a loop of wire which—when energised by the output of an audio amplifier — creates a magnetic field that varies with the modulation.

The way in which the amplifier is connected to the loop is shown in Fig. 1. The 10-ohm potentiometer controls the volume in a moultor speaker and the overall intensity of the magnetic field, so as to give the best reception over the area served by the loop.

It has been found preferable to use two loops in parallel, one about 5 feet and the other about 3 feet from the ground. This gives the most even distribution of the field and assures equally good reception, whether the wearer of the phones is lying down, sitting or standing.

Ordinary double cotton-covered wire of about No. 18 gauge may be used, but the Magnetic Broadcasting Co., London, England, which makes the Stethophone, has brought out a more convenient and more easily installed material for the loops.

This consists of wire of suitable gauge embedded in transparent tape, which is simply pressed on the wall.

Fig. 2 shows the details of one earphone. The horned pole pieces, made of laminations of high-permeability material, are so designed as to concentrate the flux from the surrounding field.

There is a small air gap between them and the circular armature attached to the phosphor bronze diaphragm.

The field does not induce any electric current in the earpiece, whose operation is entirely magnetic. The rotatable permanent magnet provides the necessary permanent polarisation.

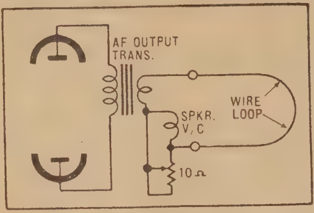


Figure 1: One method of connecting the induction loop into the voice coil circuit of an ordinary receiver.

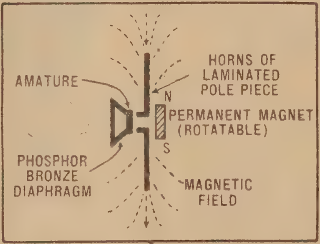

AMATURE
HORNS OF LAMINATED POLE PIECE
N
PERMANENT MAGNET (ROTATABLE)
S
PHOSPHOR BRONZE DIAPHRAGM
MAGNETIC FIELD

Figure 2: Details of the magnetic earphone.

At the base of the cap of each earpiece is a knurled disc. This is attached to the permanent magnets, enabling them to be moved and providing a volume control.

There is, in fact, a separate volume control for each ear, which makes the apparatus particularly useful to those whose hearing is better in one ear.

The horns of the pole pieces are so arranged that they always set themselves vertically, even when the wearer is lying down. This is necessary in the case of bedridden patients in a hospital.

The earpieces contain nothing which can be injured by heat or moisture — a feature which appeals most strongly to hospital authorities. They can be boiled, sterilised or disinfected by any of the approved methods.

In the United States the Stethophone is distributed under the name of Induct-O-Phone. It is claimed that the output of a 10-watt amplifier fed into an aluminium or copper wire loop encircling a building gives perfect reception for an area of 1,000 square feet.

To get best output, it is advisable to match the output of the loop with the output of the amplifier. A small autotransformer can be purchased or made as follows:

Wind 70 turns of No. 20 cotton-covered magnet wire, with four tapping points. (Use any small I or E section of laminated core.) The start of the coil is tapping point 1. the 40th turn is tapping point 2. the 55th turn is tapping point 3 and the 70th turn (end of coil) is about point 4.

To match the output with the loop, connect the output terminals of the amplifier to tapping points 1 and 4 of the autotransformer. Calculate the impedance of the loop as follows: multiply the length of the loop with the resistance shown in Table 1 and divide by 1.000.

Table II locates which output of the autotransformer is closest to the impedance of the loop. Connect the loop to the proper tapping points of the output transformer.

WATER ACTIVATED BATTERIES

RECENTLY announced in England is a new water-operated battery intended for use in life-saving apparatus at sea. The cells consist of special dry charged plates of cuprous chloride, which remain completely inert while protected from moisture by a sealing tape or some similar means.

In an emergency the tape is ripped off and as soon as the plates come into contact with either salt or fresh water the battery is energised. Once begun the discharge then continues until the capacity is exhausted.

Typical examples are two sizes developed for inclusion in Mae Wests and other air sea rescue equipment. Sewn into the life jacket, the battery illuminates a 1.5-volt bulb consuming .24 watt mounted on the shoulder. The smaller of the two, weighing only 2¼ ounces, will burn for 12 hours, and the larger, weighing 4 ounces, for 24 hours.

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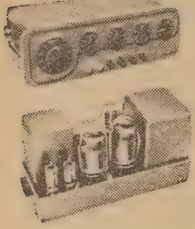

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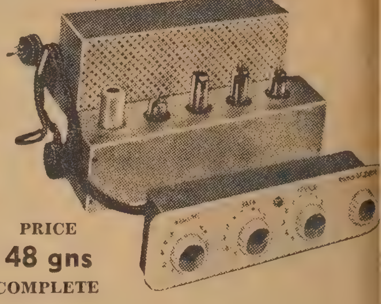

PRICE
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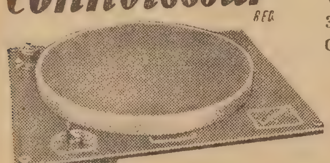

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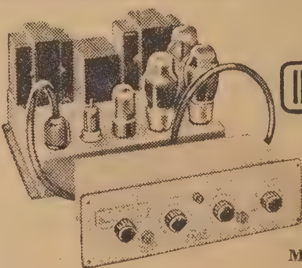

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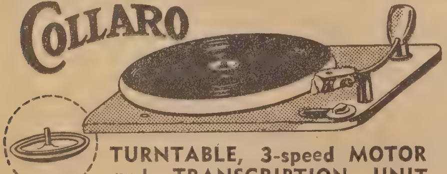

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HOW TELEFUNKEN VARIABLE-PITCH RECORDS ARE CUT

The release of "extended play" or "EP" recordings is yet another development in the struggle to get more and better music from gramophone records. This article, a precis from the Dutch magazine Radio Bulletin, gives some of the background and detail of this relatively new recording process.

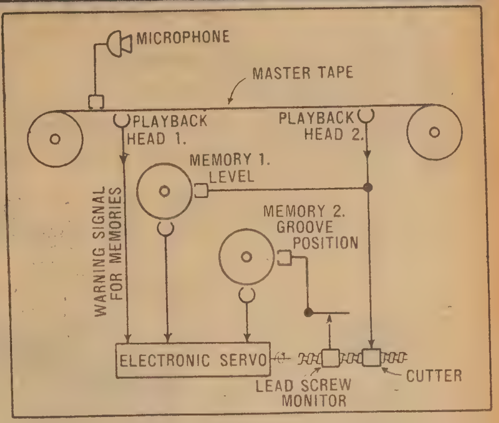

Figure 1: In Rhein's recording system, "memory" drums feed his computer and servo mechanism with information on what has been recorded, as well as what is being recorded and what is yet to come.

THOUGH the basic idea behind extended play recordings has probably occurred to many recording engineers over the years, numerous difficulties have had to be overcome before it could be put into practical form.

Of the approaches adopted by the various recording companies, that used by Telefunken is of special interest, being based on work by the German physicist, Edward Rhein.

The results of experiments by Rhein, accompanied by a practical demonstration, were first made public in July, 1950. Rhein's experiments were concerned with the problem of extending the playing time of all gramophone records generally, both standard and microgroove. They involved some fifty patents, issued between 1942 and 1954.

78 RPM RECORDS

Shortly after Rhein's work was made public, the Deutsche Grammophon Co., which had also been working on the problem, released their "Variable Micrograde" recordings designed for use on standard 78 rpm playback equipment.

These records, which aimed to give the "small man" more for his money, gave the Deutsche Grammophon Co. an advantage in the field, because they were on the market before Rhein's method was applied to commercial record production.

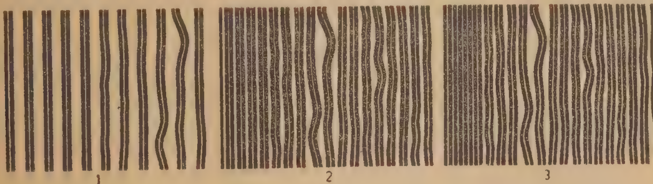

Figure 2: Illustrating (1) normal recording (2) normal variable pitch recording and (3) variable pitch using the Rhein system, where the groove wall thickness is varied as well as spacing.

This was not because Rhein's method was unsuitable for mass production techniques, but rather because the inventor felt that there was room for improvement, both as regards a further saving of space and also better playback characteristics.

It was not until 1952 that Telefunken took Rhein's work over and tooled up to market EP records using it.

Rhein's first experimental record, on which the groove spacing was governed by the peak amplitude in the previous groove, was cut early in 1943. Not satisfied with the result—characteristic of scientists—he kept on experimenting.

Some of the difficulties he encountered were enormous. Groove spacing on EP records must be as close as practicable, but must also give a reasonable protection against the pickup skipping a groove.

For such exacting work, machines had to be designed, which were capable of working to a tolerance of at least 1-10,000th of a millimetre The associated electronic servo mechanism also had to maintain these tolerances, if the cutting head was not to run into the previous groove or into the space provided for the following groove.

Mains voltages feeding the instrument had to be stabilised within extremely close limits, if the master was not to be ruined by line-surge effects. Many other variables had to be taken into account and carefully calculated, before a complete recording instrument capable of standing up to the exacting specifications was produced.

Finally, in 1948, Rhein succeeded in overcoming the difficulties and produced a machine which enabled him to gain 30 pc to 40 pc more playing time on any given size of disc.

As mentioned at the beginning of this article, the first practical demonstration of the new recording technique was given in 1950.

Another significant feature was added the following year, in the form of a control, which permitted not only the general groove spacing to be varied, but also the minimum spacing between adjacent peaks. On records cut according to Rhein's method, the minimum distance between adjacent peaks varies from [illegible] mm to .035 mm, depending on the nature of the recording.

On normal recordings this minimum distance is held constant at .025 mm, more or less irrespective of recording amplitude.

In the Rhein system, the higher the amplitude of the groove, the thicker is the separating wall between them. This eliminates the risk of cutting across grooves but, at the same time, increases the available recording space by 80 pc to 12 pc, because it effects such enormous economics with lightly modulated grooves.

Furthermore, the dynamic range of the recording can be extended far beyond that of conventional records, because the risk of groove breakdown on loud passages is reduced.

When Telefunken took over Rhein's equipment and patents in 1952, it was found, after exhaustive tests, that he had achieved a high degree of perfection possible with his apparatus and there was nothing to stand in the way of commercial production.

MICROGROOVE AND 78

The first extended-play 12-in records were released for the market by Telefunken towards the end of that same year.

In 1953, Telefunken applied Rheins method to the production of its 7-in 45 rpm records and the method is now the standard process for most records released by this company.

Although there seems to be very little difference between a normal and an EP record, when examined with the naked eye, the difference becomes very obvious under a powerful magnifying glass.

In some parts, the grooves in an EP record are very closely spaced whilst, in other parts, the spacing is quite wide.

As if lead by an invisible hand, the cutting stylus is guided by the electronic servo mechanism to a most suitable position on the disc to conserve space and, at the same time, vastly improve the dynamic range.

While standard playback equipment is adequate, the recording equipment required is extremely complex and expensive and this is reflected somewhat in the cost of the finished disc.

Readers may wonder how the

(Continued on Page 118)

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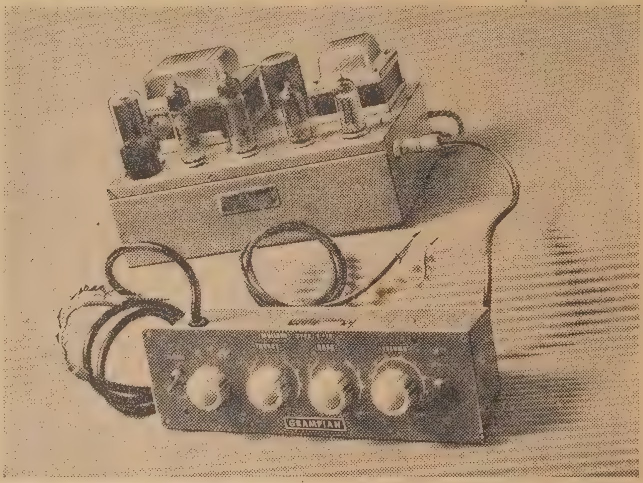

ECONOMY

MULLARD

This amplifier, based on the well-known "Mullard 5-10", incorporates some improvements on the original layout. It is intended for use with crystal pickups and fully complies with the circuit specification. The separate control unit which can be fitted in the top or front of the cabinet has a mains on/off switch, pilot lamp, volume control, bass and treble tone controls and three position switch giving the necessary compensation for L.P. and 78 r.p.m. records or radio input. The circuit is a three-stage one with 26db of negative feedback taken from the output to input stage. The high gain input stage, EF86, is directly coupled to the phase splitter, ECC83, which feeds the output stage employing two pentodes in push-pull, 2-EL84. H.T. supply is by a GZ30 rectifier valve.

TECHNICAL DATA

Power Output, rated	10 watts
Power Output, maximum	12-13 watts
Total Harmonic Distortion	Less than 0.4 pc at 40c/s Less than 0.2 pc at 400 c/s Less than 0.3 pc at 2.000 c/s
Hum and Noise	—73db relative to 10 watts
Frequency Response	plus or minus 0.5db 10 c/s to 20.000 c/s
Input impedance, pickup	1 megohm
Sensitivity, pickup	600 m.v. to give max. output
Sensitivity, radio	350 m.v. to give max. output

Treble tone control, continuously variable	—10 to +10 db at 10,000 c/s
Bass tone control, continuously variable	—5 db to +11 db at 20 c/s
Ouptput impedance	15 or 4 ohms
Mains supply	200-240 volts A.C. 50 c/s
Mains consumption	72 watts
Supply available to radio unit	H.T. 250 volts 40 m. amps. Heaters 6.3 volts 3 amps
Finish	Old Gold Hammer

RETAIL PRICE 46 Gns

Supplied complete with 10 feet three core mains lead, screened leads for pickup and control unit to amplifier, co-axial socket for radio input and one pickup equaliser, type U giving substantially correct equalisation for most types of crystal pickups. Special equalisers for Collaro, Acos and Garrard heads will be available.

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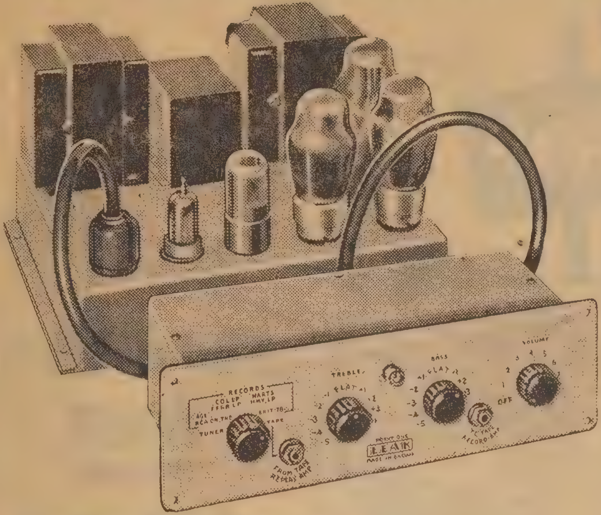

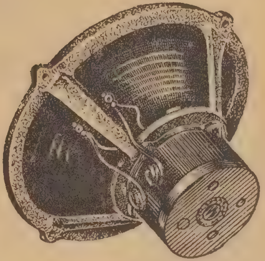

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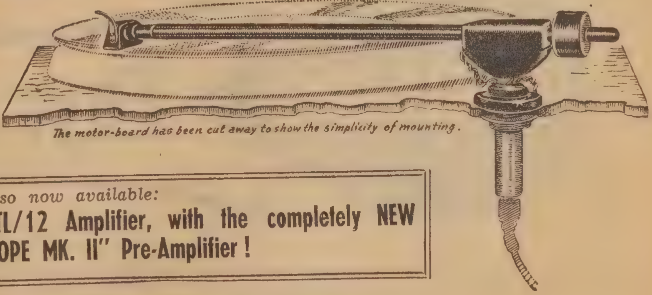

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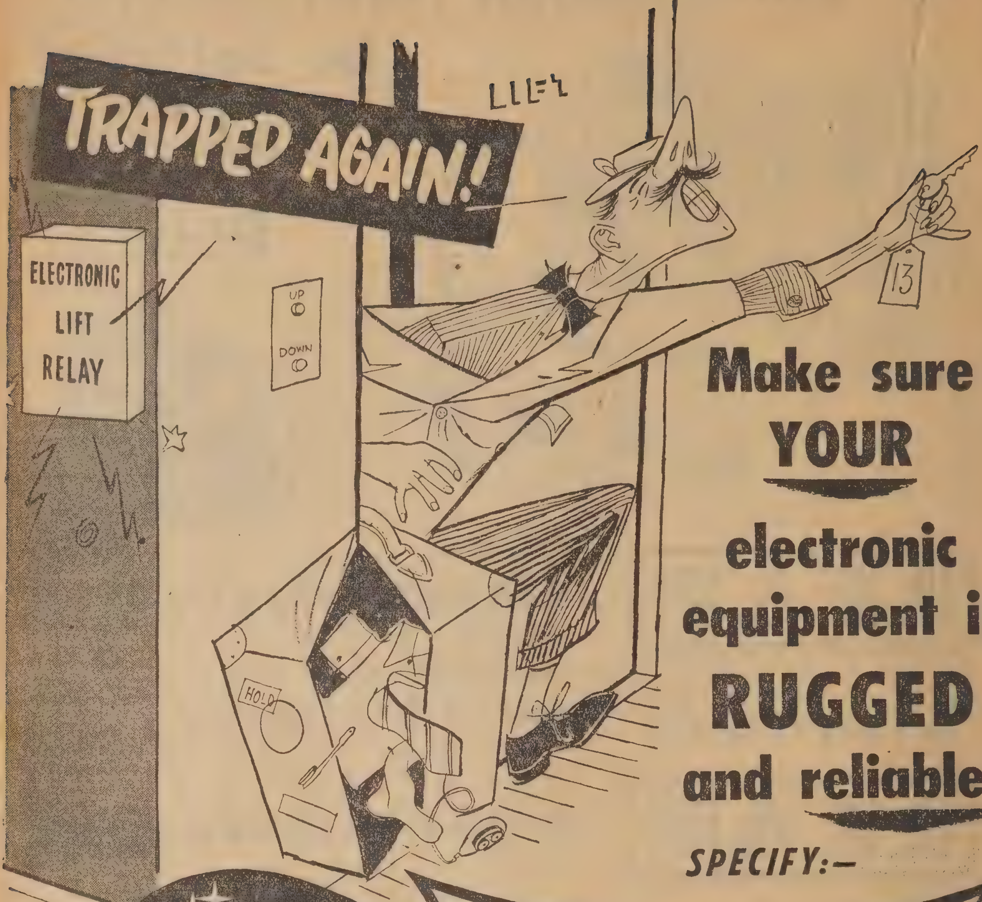
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NEWS AND VIEWS OF THE MONTH

Large-screen TV

TELEVISION for the auditorium is the latest word from the RCA Tube Division, which has announced a new 5-inch projection kinescope capable of producing black-and-white TV pictures measuring up to 8 x 6 feet when it is used with a suitable reflective optical system.

The new kinescope is expected to find wide use in closed-circuit types of large-screen TV projectors used for demonstration, training and educational purposes.

Among its features are an aluminised white fluorescent screen with high stability under varying conditions of screen current, and an operating maximum voltage of 40,000 volts—unusually high for a tube of this type.

Atomic heating

IT was suggested at the annual meeting of the Institute of Boiler and Radiator Manufacturers in New York recently that it should be possible by 1958 to start producing home heating and cooling systems operated by baby nuclear reactors. These reactors would be about twice the size of car batteries.

Mr. Ferry, general manager of the institute, said that the only thing that might hold up the manufacture of "atom boilers" was an inadequate supply of fissile material at economic prices.

A single charge of fissile material, hermetically sealed in the reactor would last for six years and cost about £100. When the charge was exhausted the reactor would be replaced with another sealed unit.

The reactor would be connected with a boiler which would be situated in the basement or garage. The entire installation for a new house would cost about £500 and this would be less than the cost of a conventional heating system, because the chimney and flues would be unnecessary.

Tune by light!

"FLASH TUNING", demonstrated recently by the US Zenith Company, uses a pistol-grip flashlight to permit the TV viewer to turn the set on or off, change channels or cut out the sound during long-winded commercials.

Receivers using the Flash-Matic system have four photo-electric cells, one at each corner of the picture tube.

A beam shining in the lower left-hand corner turns the set on or off. Channels are switched through the upper two cells: the one on the left turns channels counterclockwise, the other changes channels clockwise. The lower left-hand cell cuts out the audio—a second flash brings it back.

The photo-electric cells controlling channel selection operate a single motor. Channels are tuned in sequence. If the light is projected on either cell for more than an instant, several channels will be covered.

Can beat H-bombs

A SENIOR defence scientist stated in Melbourne recently that rocket-borne atom-bombs were being planned to counter H-bomb attacks

He is Mr. W. A. S. Butement, chief scientist of the Australian Defence Scientific Service.

He told the Science Congress at Melbourne University that radar could detect the H-bomb-carrying rocket at great distances.

Radar could determine its trajectory electronically in two seconds.

Mr. Butement said that after its track had been discovered, a defensive rocket with an atomic warhead could be sent up to intercept the H-bomb.

The defensive rocket would explode in the path of the H-bomb rocket, which would then run into a ball of fire.

This would cause the H-bomb to explode harmlessly at a great height.

Filter-board

US GOVERNMENT scientists have developed a wood fibreboard which filters poison gas, germ-laden particles and radio-active materials from the air.

The material is called "diffusion board".

The United States Forest Products Laboratory and the Army Chemical Corps developed the board.

It looks like ordinary fibreboard used in homes, but contains secret chemicals that screen out deadly gases and particles.

Dr. J. A. Hall, director of the laboratory, said the new material could be used in new-type shelters to protect civilians and soldiers from some of the worst effects of modern war.

Dr. J. Stamm, a research scientist at the laboratory, said the diffusion board would let oxygen through and carbon dioxide out.

This would allow breathing in a shelter while keeping deadly particles out.

Any species of wood pulp could be used to make the board, he said.

POPULAR SCIENCE QUIZ

Q.: What are solstices and when do they occur?

A.: The solstices are the two moments of the year when the sun in its apparent motion attains its maximum distance from the celestial equator. The solstice of June 21 is the sun's passage through the first point of Cancer. The solstice of December 22 is the sun's passage through the first point of Capricorn.

Q.: Have any practical suggestions been made for the use of small nuclear reactors for domestic applications?

A.: At a recent meeting of the Institute of Boiler and Radiator Manufacturers in New York it was stated that it should be possible by 1958 to manufacture reactors of some two cubic feet in size to use for domestic heating and cooling systems.

The reactor would be a sealed unit and the initial charge would last some five or six years when it would be replaced by a completely new unit. The cost of the unit was estimated to be about £100 and the entire installation would amount to £500.

However, as the usual chimney and flues would not be required the cost of the new installation would not be any greater in new homes than conventional methods of heating.

Q.: What is a Rayleigh refractometer and on what principle does it operate?

A.: It is an instrument for measuring the refractive index of a gas. It measures this value by an optical interference method. Each of two interfering light beams passes through a tube which may contain air or gas or be evacuated. By observing the shift of the interference fringes when one of the tubes is evacuated and the other contains gas, the refractive index can be calculated.

Q.: What is the F layer?

A.: This is the upper ionised layer in the ionosphere resulting from the ultra-violet radiation from the sun. This layer is at a regular height of 300 kilometres during the night and falls to about 200 kilometres during the daylight. In some seasons this remains as the F1 layer and an extra layer known as the F2 layer rises to a maximum of 400 kilometres. Considerable variations are possible during particle bombardment from the sun, the layer rising to great heights or vanishing.

Q.: What is Bentonite and its industrial uses?

A.: Bentonite is a mineral which is used in many industries as a binding agent. These industries include the manufacture of fire resistant materials, iron founding, ceramics, dyeing, rubber and linoleum making and constructional engineering. Bentonite can also be used in the treatment and improvement of sandy soils.

It has been used for the making of granular Fullers earth which is valuable for cleansing oils and for filtering air and gas.

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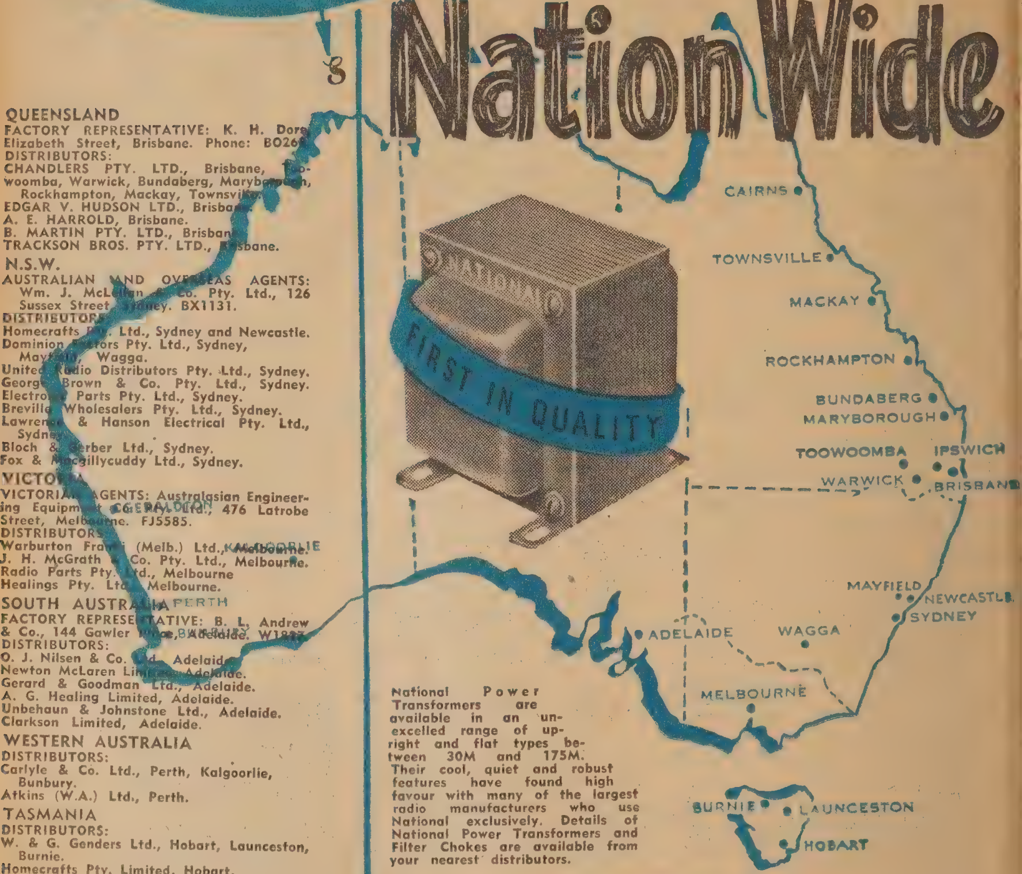
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or women drivers?

A DETROIT engineer has invented a radar-equipped car that stops automatically if something gets in its way.

Mr. Louis Rabaut, member of the US House of Representatives, recently drove in it and he reported his experience in the Congressional Record.

The car has a radar screen at the front several inches high, he said.

It projects an impulse guaranteed to halt the car should anyone or anything appear in its path.

There is another at the back for reversing.

America and back

TWO former RAF fliers recently had breakfast in London, lunch in New York and supper in London.

They had flown a British Canberra jet bomber from London to New York and back in one day—the first fliers to do it.

Captain John William Hackett, 32, piloted the plane, and Peter Moneypenny, 31, was navigator.

The round trip took 14 hr 21min and the bomber averaged 481.52 miles an hour.

Actual flying time was 13hr 46min.

The bomber reached speeds of more than 600 miles an hour.

Hackett told reporters he was relatively satisfied with the double crossing time, but he thought the Canberra could do the trip faster.

Sea gnat

AS a result of overseas inquiries, Folland Aircraft Ltd. have designed the Sea Gnat for operation from all types of aircraft-carrier.

By virtue of the Sea Gnat's small size, there will be no need to make provision for wing folding, which will enable the aircraft to take off with the minimum of delay once it is on the flight deck.

The Gnat will require few modifications to become the Sea Gnat—a long-travel undercarriage leg, an arrester hook and a catapult spool attachment are the main ones.

Folland declares that two chief advantages of the Sea Gnat will be a reduction in ground crew, as the aircraft is easy to service, and the fact that two to 2½ times more Sea Gnats can be accommodated in a carrier's hangar than the much larger current conventional shipborne fighters.

TV telephone

A TELEVISION-TELEPHONE was demonstrated in San Francisco recently.

Called the "video-phone" or "TV-telephone", the device gives a 10-inch screen view of the person being called the instant he picks up his receiver.

The image disappears from the screen immediately either person hangs up.

In the demonstration technicians used two microwave channels to transmit sound and picture.

They said transmission could also be by wire.

Kay Lab officials said it was best adapted to large factories where a foreman or supervisor might want to demonstrate to the manager, sitting in his office, what was holding up production.

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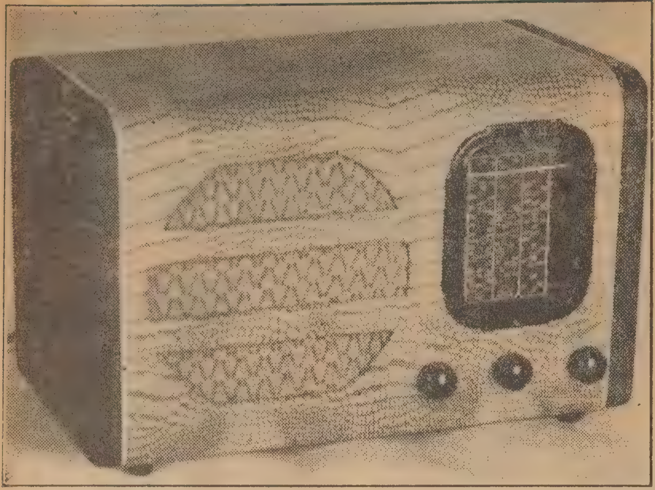


The DX Mantel receiver in its attractive Leatherette cabinet. Controls from left to right are: Tone, with On-Off Switch, Volume and Tuning.

A HIGH-SELECTIVITY SET

There are places in Australia where plenty of radio signals are available at good strength, yet reception is made difficult at night by lack of selectivity in the receivers commonly available. The set described is specially designed for such locations, for it is small enough to fit into a mantel cabinet, yet has a degree of selectivity much better than average.

by L. Varady

THE majority of current broadcast receivers are designed for—and used in—areas quite close to local stations. In most cases, the signal strength from the locals is such that adjacent weak stations are completely blotted out.

They cause no interference problems, even though the selectivity of the receiver in question leaves much to be desired. If, perchance, the user does start to fossick among the lesser-known call-signs on the dial, he is soon discouraged—but not very perturbed—by the conglomeration of signals and whistles which come through the loudspeaker.

He turns back to a familiar station and forgets the whole incident.

COMPARATIVE STRENGTH

However, the further one gets from "local" transmitters the lower their field strength becomes until it may be little above the strength of adjacent signals from further afield. This is particularly so at night time, when propagation conditions are such that even distant transmitters may produce a substantial signal level in particular areas.

This is where the problem arises because, even though there may still be plenty of field strength to overcome set noise and interference, the receiver just isn't selective enough to separate the desired "local" signals cleanly from other strong stations on adjacent channels.

Plenty of highly selective receivers have been designed in the past, capable of doing the job but, by and large, they have ranged from large console-style chassis to full-scale communication sets.

Our present problem was to evolve a design having higher than normal selectivity, yet still small enough to come within the classification of a five valve mantel receiver.

Now the selectivity of a receiver depends very largely on the number and efficiency of the tuned circuits used and, in general, it is correct to say that the more tuned circuits we have, the more selective the receiver will be.

The usual and almost automatic reaction is to suggest the addition of a band-pass aerial circuit or, better still, a complete RF stage. Either one will provide an additional tuned circuit while a complete RF stage also yields extra gain and improved signal-to-noise ratio.

But there is a catch to it when the prime objective is not so much to improve gain or signal-noise ratio but rather to obtain the highest possible selectivity for a set of a given size.

In both cases—bandpass aerial or full RF stage—the extra tuned circuit has to operate over a wide band of frequencies. Besides the minor difficulties of tracking and the need to provide an extra coil and gang section, the question of L/C ratio and operating frequency has to be considered—and a tuned circuit operating at signal frequency doesn't show up too well on either count.

DEPENDS ON Q

For example, the ultimate selectivity of a tuned circuit depends on the "Q" factor of the coil and capacitor and, by and large, is highest when "C" is large. However, in a circuit operating at signal frequency, "C" varies with the setting of the tuning gang and an optimum C/L ratio simply cannot be preserved.

Again, the standard 10 Kc separation between stations becomes a progressively smaller percentage of the resonant frequency as the circuit is tuned from 550Kc to 1600Kc—at which the circuit cannot be expected to contribute much to overall selectivity.

None of these difficulties is present in the IF channel of a receiver and it is not difficult to show that the addition of an extra IF stage can contribute far more to adjacent channel selectivity than an extra tuned circuit in the "front end".

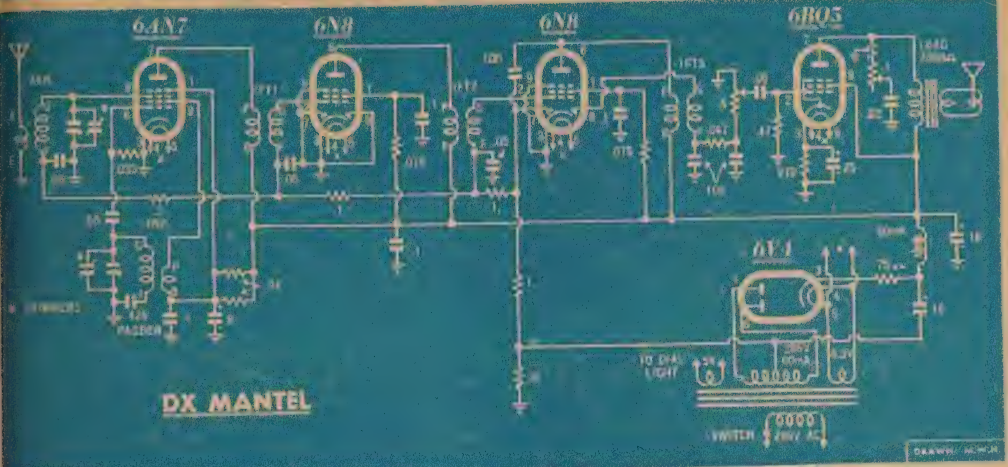
Besides the fact that an optimum C/L ratio can be provided, both the primary and secondary of an IF transformer can be resonant so that the method yields, not one, but two tuned circuits.

BASIC REASON

Furthermore, the 10Kc difference between adjacent signals represents a larger percentage of the resonant frequency of the circuit, so that a greater degree of discrimination is achieved. This, in fact, is a basic reason for the higher selectivity of superhet type receivers.

Some small deterioration in signal-to-noise ratio and image rejection must be expected, as we have increased the gain after the converter and there is still only one tuned circuit ahead of it. But this is not as serious as it might appear. Our main consideration in this set is adjacent channel selectivity, rather

THE CIRCUIT FEATURES A SELECTIVE IF CHANNEL



A more straightforward circuit could hardly be imagined for a five valve set. If the set has too much gain and tends to IF instability, the 35 ohm back bias resistor could be increased in value to about 50 ohms.

than image rejection, since we have already assumed that the signal strength will normally be adequate to override the converter noise.

One must assume, of course, that a modern converter valve will be used, together with an efficient high-gain aerial coil.

In other words, for the purpose we have in mind we have made a pretty clear case for a receiver having a conventional converter valve, two IF stages, detector and output.

Having got so far, we soon found that the housing of such a set in a mantel type cabinet presented its own problems.

Not the least of these was the provision of a suitable power supply.

The high tension requirements of the four valves selected — 6AN7, two 6N8's and a 6BQ5 — amount to just under 70 ma, for a HT of 250 volts. On the other hand, we did not want to make the chassis too large or to use an 80 ma transformer.

With the HT reduced to 225 v it was possible to foresee a current of about 62 ma, which is slightly over the rating of the next smallest transformer.

Fortunately, the current rating of transformers applies only if all windings of the transformer are fully loaded. If not the rating of another winding can usually be extended.

SAFETY MARGIN

We took advantage of this fact by using an indirectly heated rectifier, a 6V4, thus saving a current of about 1.4 amps on the rectifier filament winding. This allowed an adequate safety margin for the increased HT drain.

To spare the transformer still further we have also made the HT dropping resistor to double as a current limiting resistor between the rectifier cathode and the filter input. A resistor in this position not only reduces the voltage, but at the same time reduces the peak current through the transformer.

The remainder of the circuit is straightforward enough, although it must be stressed that the IF channel must use transformers specifically intended for two-stage operation. These are available in most brands, being marked as "low gain" or "1st, 2nd and 3rd" or something that means the same thing. Your dealer will be able to advise about this.

The two IF stages are identical, having AVC applied to them as well as to the converter. A standing bias of two volts is fed to all three valves through the AVC network, being derived initially from a back-bias resistor.

The two diodes in the second IF valve serve for AVC and detection.

No provision has been made for an audio amplifier as the receiver is not intended to be used in areas of very low signal strength. In any case, the output valve, a 6BQ5, has a very high gain and the audio stage is hardly missed.

So much, then, for the circuit. We can give our attention to the constructional details.

Checking on the cabinet position, it became apparent that a new one was not necessary, since the set could be fitted quite nicely into the cabinet originally designed for the New Fireside Five and used more recently for the DX Mantel Receiver—a set with an RF stage.

Accordingly, a prototype chassis was made up, measuring 11 7-8in. x 6in x 1¾in.

Apart from the usual valve and coil mounting holes, two cutouts of special shape are required on the chassis to accommodate the dial and the loudspeaker.

This latter will have to suit the

PARTS LIST

- 1 cabinet (New Fireside Five).
- 1 chassis, 11⅞in x 6in x 1¾in.
- 1 power transformer 285 V/60 mil.
- 1 choke 14H/60mA.
- 1 dial SLV 21.
- 1 loudspeaker 6in round or 5-7in elliptical.
- 1 7000 ohm transformer to suit speaker.
- 1 standard aerial coil.
- 1 standard oscillator coil.
- 3 IF transformers, low gain high selectivity type.
- 1 2-gang tuning capacitor. MSP min. or similar.
- 3 wafer type Noval sockets.
- 2 solid moulded Noval sockets.

VALVES

1 6AN7, 2 6N8, 1 6BQ5, 1 6V4.

CAPACITORS

- 2 16 mfd 600 V, 1 8 mfd 600 V, 1 25 mfd 40 V, electrolytics.
- 4 .1 mfd 400 V, 1 .05 mfd 400 V, 3 .05 mfd 200 V, 1 .02 mfd 600 V paper tubulars.
- 1 425 pf padder, 3 100 pf, 1 50 pf micas.
- 2 trimmers.

RESISTORS

- 2 1. meg, 1 .47 meg, 2 .1 meg, 1 .047 meg, 1 .033 meg, 1 35 ohm, all ½ watt.
- 2 .075 meg, 2 .04 meg, 1 210 ohm, all 1 W. 1 75 ohm 3W. 1 .5 meg pot, 1 .1 meg S/pot.

SUNDRIES

Hookup wire, tinned copper wire, spaghetti, solder, bolts and nuts, solder lugs, 2 2-terminal, 4 3-terminal, 1 5-terminal tagstrips, shielded hookup wire, mains flex and plug, 6 x 7in piece of ¼in plywood, or hardboard, 3 knobs.

Q PLUS TUNING UNITS NOW HAVE *A Little Brother!!*

TYPE: QW5. A SINGLE STAGE "PRE-FAB" TUNING UNIT WITH:—P.U. CONNECTIONS, B/C AND ELECTRICAL BANDSPREADINGS ON 19, 25 AND 31 METRES.

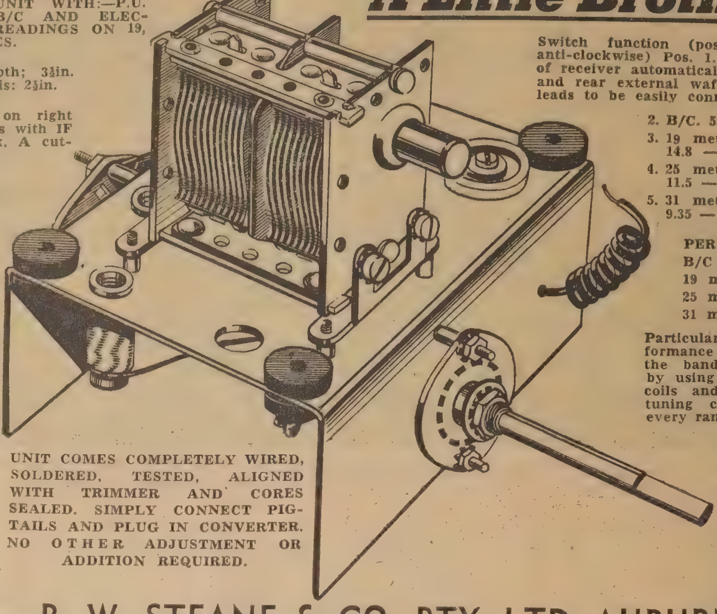
SIZE:
Length: 4½in; Depth; 3½in. Height: 5½in. Chassis: 2½in.

MOUNTING:
Unit is mounted on right hand side of chassis with IF channel along back. A cut-out 3½in x 3in is required with 4 mounting holes, centres 3in and 4in apart.

IF CHANNEL:
Standard Hi gain Q plus IF8 plus IF9
Midget Hi gain Q plus IF1 plus IF2

CONNECTIONS:
Rear corner (3 leads)
Blue — IF plate of 1st IF transformer
Yellow — A.V.C.
Brown — HT plus (250 v approx.)

REAR CENTRE (2 leads)
Yellow — filament supply (6.3v)
Brown — screen supply (100v) Normally in parallel with IF amplifier screen.
Front (1 lead)—aerial



UNIT COMES COMPLETELY WIRED, SOLDERED, TESTED, ALIGNED WITH TRIMMER AND CORES SEALED. SIMPLY CONNECT PIGTAILS AND PLUG IN CONVERTER. NO OTHER ADJUSTMENT OR ADDITION REQUIRED.

Switch function (position 1 max. anti-clockwise) Pos. 1. P.U. R.F. end of receiver automatically switched off and rear external wafer allows P.U. leads to be easily connected.

2. B/C. 530 — 1640 Kc/s
3. 19 metre bandspread 14.8 — 15.6 Mc/s.
4. 25 metre bandspread 11.5 — 12.1 Mc/s.
5. 31 meter bandspread 9.35 — 9.9 Mc/s.

PERFORMANCE:

B/C	3 uV
19 metre	16 uV
25 metre	13 uV
31 metre	10 uV

Particularly good performance is obtained on the bandspread ranges by using separate H.Q. coils and a low total tuning capacitance on every range.

VALVE TYPE:
Unit requires addition of: 1—6AE8 converter.

DIAL:
EFCO bandspread type USL 51.

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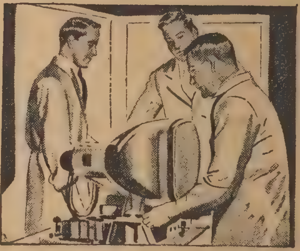

A night class T.V. training group is now in process of formation. Commencing date is anticipated early in October. Enrolment is restricted to those with a basic knowledge of the theory and practice of radio service. The course will comprise weekly lecture demonstrations, lesson reference books, and will conclude with a period of individual laboratory practical work on T.V. equipment. This course will appeal to radio servicemen, technicians, retailers and advanced students. Priority for inclusion in the group will be kept strictly in the order in which enrolments are received.

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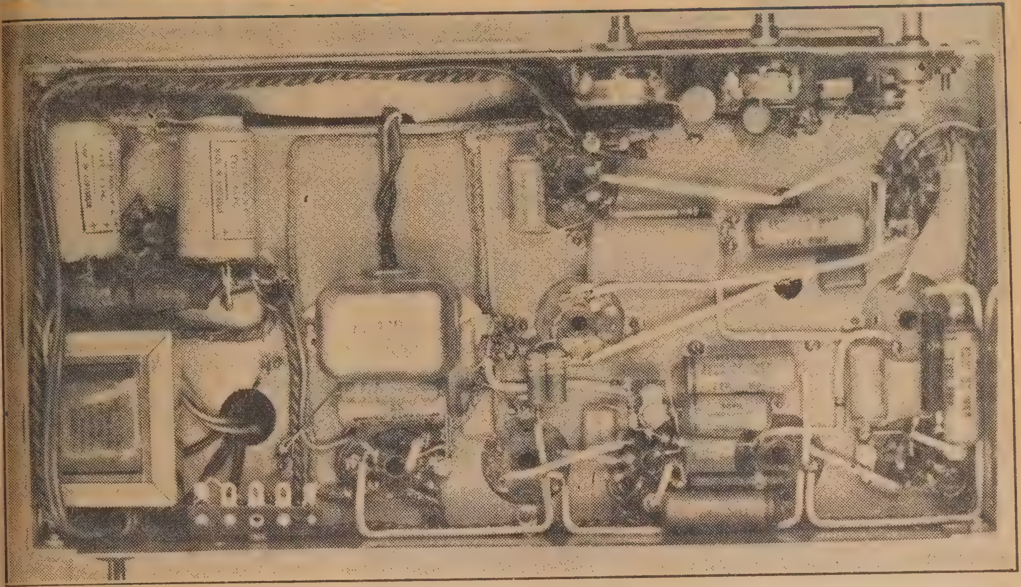
UNDERNEATH VIEW SHOWS LAYOUT OF COMPONENTS



There is plenty of room for all components underneath the chassis. A bigger output transformer could be fitted, provided it can be accommodated in depth. Note the AVC bypass condensers near their respective valve sockets.

speaker you elect to use. The prototype receiver, as seen from the illustrations, used a 5-7in elliptical speaker, because of its more favorable characteristics, and smaller overall height.

At the same time, however, there is sufficient room in the cabinet to clear a standard 6in speaker, although a different chassis cutout, somewhat deeper than the one shown, will be required. There is no special problem about this which a few minutes' work with a file and drill will not fix.

Looking at the chassis from the front, the different stages follow around the edge of the chassis in their logical sequence, starting with the converter valve right behind the dial.

TONE AND VOLUME

The tuning gang is placed next to the converter valve and beyond that again are the aerial and oscillator coils.

This does make the leads to the oscillator coil rather long, but it is not likely to cause any bother at the frequencies involved.

There is plenty of room next to the output valve socket underneath the chassis to allow any of the usual size of output transformers to be used. The right-hand side of the chassis is taken up by the power supply, the power transformer and rectifier being above the chassis, the choke and filter capacitors below it.

Tone and volume controls are mounted beneath the dial assembly.

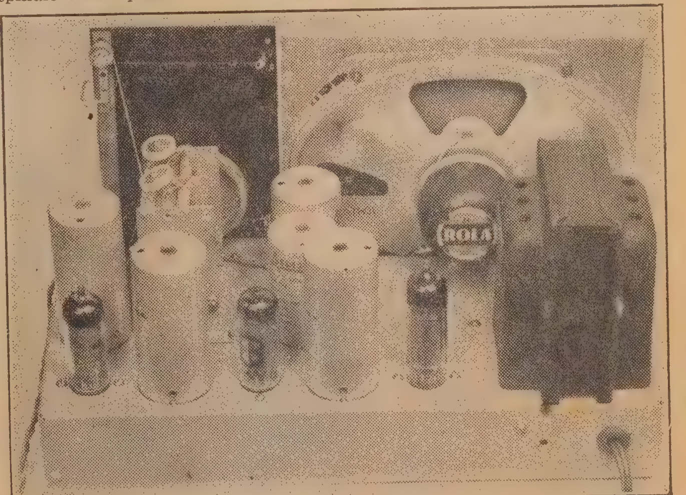
The mounting of the dial needs some care and forethought. Whenever we use a ready-made dial, we try to utilise the existing threading arrangement but, unfortunately, this was not practicable with the present set.

The only dial available at present, which fits both the receiver and the cabinet is an SLV 21 type. However, minor modifications are necessary before it can be fitted.

The cord and driving spindle must be removed, the two lower corners cut off at an angle and the central spindle hole opened out. This is necessary to prevent the dial plate fouling the control spindles and to bring the dial spindle into line with the other two. The dial drive spindle is mounted on the chassis.

With the tuning gang in position, the dial plate can be fitted and the cord restored to its proper position. As this is different from the original threading arrangement, we give a small diagram showing the new arrangement.

Note that the lower pulley on the



This top view will help you in placing the major components.

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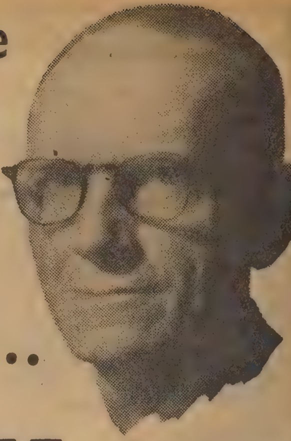

"'SCOTCH' Brand Sound Recording Tape is used by 2GB Macquarie" says Mr. H. K. R. Thomas, Chief Sound Recording Engineer.

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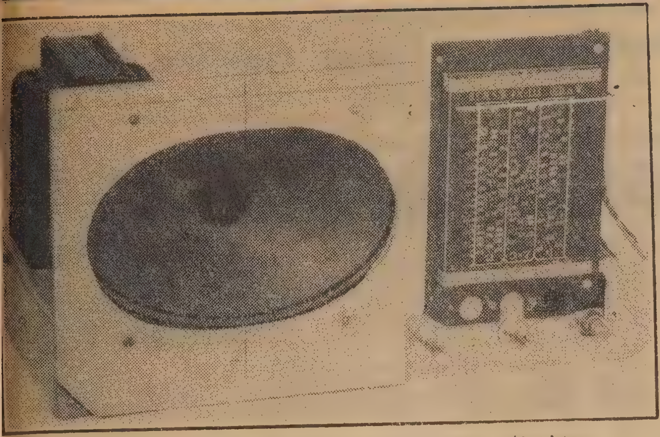
FRONT VIEW OF THE RECEIVER



Dial mounting and loudspeaker baffle are clearly shown in this picture.

slider is not used, the cord going directly to the driving spindle from both the pointer and the drive drum.

The wiring of the receiver is quite straightforward, point - to - point. However, it must be remembered that the IF channel has considerable gain, in spite of the fact that low gain IF transformers are used. This means, that grid and plate leads of the two IF valves and the converter must be kept apart as far as possible.

This should not present any difficulties, if the original layout is followed. It may as well be mentioned, that the AVC diode connection on the second IF valve socket carries the full RF output from the valve. The AVC filter resistors should therefore be mounted as close to the diode pin as possible, to avoid feedback into the preceding grid circuit.

WIRING

Also the oscillator plate and grid leads, which have to be fairly long. should be kept away from the IF sockets. We thought of shortening these leads by mounting the coils on their sides underneath the chassis but decided against it on the grounds that it so complicates the wiring procedure.

In order to keep stray capacitive coupling down to a minimum, it would be advisable to use wafer-type sockets for all valves handling RF. On the other hand, the rectifier and output sockets can well be of the solid moulded type.

We suggest that the sockets and coil terminals be oriented as follows:

Converter socket with gap toward the power transformer; IFT 1 grid and AVC pins toward rear corner; 1st IF socket with gap facing the volume control; IFT 2 with plate and grid terminals facing the respective valves; 2nd IF socket with gap toward dial spindle; IFT 3 with plate and HT pins facing the preceding valve.

The orientation of the aerial and oscillator coils is not critical but, as a matter for the record, we placed them with the grid pins toward their respective gang connections. It may also be mentioned here that the aerial lead is taken above the chassis right next to the aerial coil. It passes through underneath the tuning gang and back to the underside of the chassis near the edge.

Here it is twisted up with an earth-wire attached to a convenient lug and brought out from the cabinet alongside the chassis. This rather involved route is desirable to prevent the aerial lead from picking up any stray RF that may be floating around underneath the chassis.

Placement of the various by-pass capacitors is obvious enough from the photograph, but it is important to note that the AVC by-pass capacitors are earthed near their respective valve sockets.

The audio end of the receiver is simplicity itself. A small tag strip near the third IF transformer supports the components of the RF filter after the detector, from where the audio signal is taken to the volume control. From here another shielded lead takes the signal to the grid of the output valve.

A small tag strip near the volume control is used to support the coupling capacitor, while the cathode resistor and bypass fit neatly alongside the valve socket.

TOP CUT NETWORK

A simple "top cut" network at the plate of the output valve constitutes the tone control. As this control is also mounted at the front of the set and the lead to it is rather long, shielded wire should be used to connect it. The tone control potentiometer also carries the mains switch, a convenient feature, if the set is operated from a power point some distance away.

The mains lead is taken straight to the switch and then to the appropriate tapping on the power transformer. These tappings can be seen in the photograph connected to the tag strip near the filter choke.

While the HT secondary leads are connected directly to the rectifier socket, the two filament windings are terminated on two tag strips, which also support the "hot" ends

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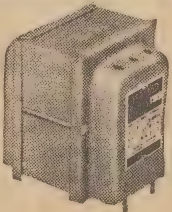

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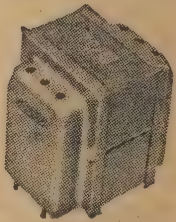
Mullard "5-10" AMPLIFIER



TYPE OP 308	TYPE PF 1073	TYPE PF 1072
Suit low and high load conditions.	For low and high load conditions AMPLIFIER ONLY	For low and high load conditions AMPLIFIER AND TUNER
Prim: 8000 ohms PP 6000 ohms PP	**Prim:** 230-240 volts	**Prim:** 230-240 volts
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O/Put: Rated output 10 watts maximum output 12-13 watts.	**Sec:** L.T. 6.3V/2A, 6.3/1A (6V4)	**Sec:** L.T. 6.3V/4A, 6.3V/1.5A, (2 x 6V4)

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t the filter capacitors. From here, oth the DC HT and the 6.3v filaient leads are taken to the output alve socket and then along the rear dge of the chassis to the other ages.

As mentioned earlier in the article, ie 5v rectifier winding is not used. Iowever, there would be no objecon to connecting the dial light to it, so desired, thereby ensuring good fe for the globe.

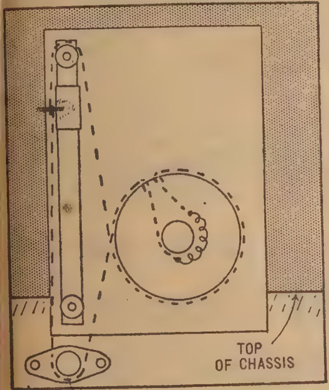
Another small tag strip underneath ie speaker supports the back-bias ilter capacitors.

While on the subject of power ipply, it would be wise to mention iat the current limiting resistor etween the rectifier cathode and the rst electrolytic should be of at least W rating, as it is required to carry airly heavy current. It should also e kept clear of the body of the filter apacitors, as it is likely to get ather hot.

As a last item there remains the iounting of the loudspeaker. This is xed to the chassis on the inside of he cutout by its lower mounting oles. Actually this sets it back about in from the cabinet, so that it will e necessary to secure a small baffleoard of that thickness in front of it.

This should have just about comleted the receiver, and after a check o see if filament and HT connection ave been made correctly, the set ould be switched on and aligned.

The alignment procedure is the ame as for any other superhet. It could be carried out in the normal manner by ear although, for best results, a signal generator and an output meter are really essential.



Dial cords are tricky. Dotted line show where it should go on this set.

This is because a maladjustment of one of the IF transformers could widen the bandpass of the IF channel sufficiently to reduce the performance.

Correctly aligned the performance of the set is really surprising. The selectivity is as sharp as one could wish for on a broadcast receiver and there is sufficient gain to make the set useful even in areas of low signal strength.

Excellent results were obtained on test on the Blue Mountains area in NSW, where, in the writer's experience, ordinary mantel receivers leave much to be desired as regards adjacent channel interference.

Tested in a Sydney suburb one evening, with only about 10 feet of aerial, about 63 stations were counted in a single run around the dial, all of them at useful strength.

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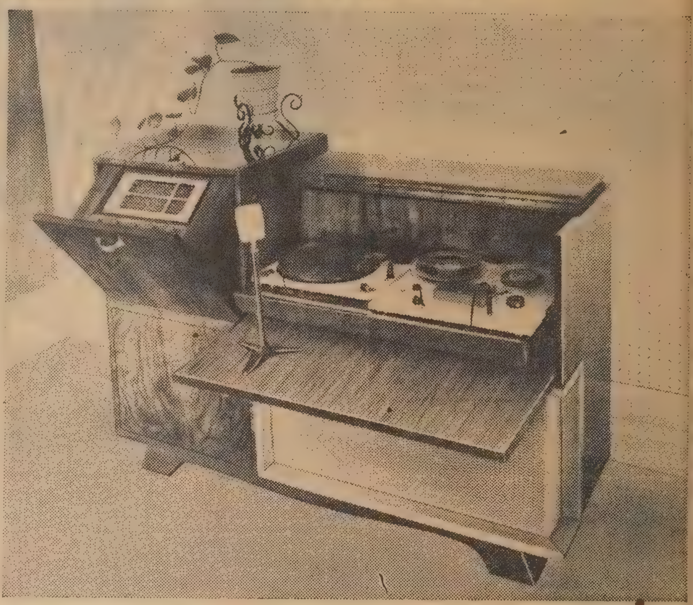

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HOW MANY SPEAKERS DO I NEED?

A general discussion of some problems which confront the designer of single-coned speakers for wide-range response and the advantages to be gained by the use of multi-speaker systems as a means of improving frequency response and reducing distortion. This article may be considered as an introduction to a description of loudspeaker cross-over networks which appears elsewhere in this issue.

THE emphasis on high quality sound, particularly in the last ew years, has highlighted the difficulties which confront the loudpeaker manufacturer in attempting o cover a wide frequency range, with low distortion, using a single one.

The purpose of a loudspeaker is o translate the electrical output rom the amplifier into sound energy which, when radiated into the room, brings the reproduced music to our ears.

For this reason, a loudspeaker is often called a transducer, which more accurately describes the work t has to do.

MOVING COIL SPEAKERS

At the moment, by far the most popular type of loudspeaker uses a cone actuated by a moving coil mounted at the apex and suspended within the field of a strong magnet.

The output of the amplifier is fed to the coil and the interaction between the constant magnetic field of the magnet and the varying field set up by the coil when it is energised, causes the cone to move backward and forward, producing the necessary air waves as it does so.

It is obviously desirable that the vibrations of the speaker cone be capable of producing faithfully all manner of waveforms, from simple sine waves to extremely complex shapes, as encountered in speech and music.

Because these complex waveforms are actually the products of numerous sine waves, representing fundamental tones plus their harmonics, we can say that wide range and faithful reproduction cannot be achieved unless the cone can reproduce sine waves from the lowest audible frequency up to and including the highest frequency found in any sound being reproduced.

THE UPPER LIMIT

Just where the upper limit falls, in terms of frequency, is a moot point which need not be argued here. It is enough to say that the range would certainly have to extend up to 10,000 or 15,000 cycles for very good equipment, and probably into the supersonic region for the highest fidelity.

The limit probably lies at a frequency not lower than that which requires the ear mechanism to accelerate at its maximum possible rate. This will vary with individuals, and with the age of individuals, and leads us into fields which involve not only physical but psychological reactions as well.

For instance, it is possible that the character of audible sounds may be affected by components which are too high to be heard in the ordinary sense of the word, but which lie within the range of feeling.

It is certain that the nervous system is aware of sounds which the ear itself may not hear. This may well justify the thought that high fidelity involves frequencies well into the supersonic region.

For the purpose of this discussion, we can group the sounds which the loudspeaker must handle into three bands—the first from the lower limit of audibility to about 1000 cycles, the second from about 1000 to about 6000 cycles, and the third from 6000 cycles to the upper limit, whatever this may be.

We will call the first range the low range, the second the middle, and the third the high range.

It is extremely difficult to make a single speaker which will handle these three ranges adequately.

DESIGN COMPROMISE

The reason is that the mechanical requirements of a speaker for the reproduction of low frequencies are not the same as those needed for good performance on high frequencies.

In fact they are almost diametrically opposed and any single cone speaker intended for full range reproduction must be a compromise in design.

It is quite true that many of these "compromises" are very good on a comparative basis, and some are most ingenious. But it is generally agreed, and it is found in practice that for the best results from a speaker system, separate high grade units are preferable, each being used to reproduce a single section of the sound spectrum for which it is specifically designed.

Thus we may find a special low frequency "woofer" used for the low range, a middle frequency speaker for the middle range, and a "tweeter" or high frequency speaker for the high range.

by John Moyle

In less elaborate, but less costly systems, two selected speakers are used with success, one for the low range and another to reproduce both the middle and high range.

A third combination is often seen, in which the first speaker is designed to reproduce the low and middle ranges and is used with a tweeter to carry on from about 6-8 Kc as high as is practicable or desirable.

It is interesting to examine some of the reasons why a full range speaker is so hard to make and in what manner a good low-range speaker differs from a higher-range speaker.

The cone of the low-range speaker has to move comparatively slowly, the lower the frequency being reproduced, the more slowly it has to move.

When a speaker is reproducing a bass note, it is quite easy to see the movement of the cone and to feel the air disturbance it sets up by its movement to and fro.

In this respect it may be considered as an air pump coupled to the air in the room and, if it is to reproduce bass notes in a convincing manner, it must have the ability to initiate quite powerful sound waves.

Only a strong, heavy cone can do this, one which will not buckle under the pressure of air upon its surface. Its construction and its suspension must allow it to make a considerable movement without being unduly restricted, at the same time holding it centrally in the voice coil gap.

IMPORTANCE OF LINEARITY

If the suspension were unduly stiff, the movement of the cone would be checked near the extremes of its movement, and this would give a non-linear relationship between the electrical currents fed to it, and the sound waves it produces.

Such non-linearity is the prime cause of severe and objectionable distortion.

Woofer cones usually have corrugated type spiders to give a suspension just "springy" enough to bring the cone to a central reference point when at rest, and a soft outer suspension, sometimes in the form of a soft leather or fabric ring.

A heavy cone suspended in this manner has a very low period of natural resonance, sometimes only a few cycles per second and frequently between 15 and 25 cycles.

This means that response can be well maintained down to and somewhat beyond this frequency and avoids the danger of unpleasant boominess so often found with speakers having strong resonances at 60 cycles or higher.

If the cone does buckle under pressure it will not vibrate in one piece. Instead it will break up (from a sound pressure point of view only!) and produce harmonics instead of fundamental tones. It will "double" or even "triple" if the break-up is pronounced.

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Because of its comparatively large nplitude of movement, the voice il former must be a long one so at the coil does not move outside e limits of the magnet's field. Unss this field is substantially constant all times with respect to the coil, ere will be a non-linear movement the cone and distortion will relt.

The cone itself is invariably of rge diameter to provide a large ea for efficient coupling to the air. is rarely less than 12in in diameter nd big speakers often have diaeters of 15 or 18in.

Naturally, such big cones must arry larger voice coils than smaller ones, again in the interests of rigiity, and 2in diameter coils are comion.

Finally, a woofer is invariably fitd with a very large and powerful iagnet structure. This is essential develop good sensitivity, and parcularly to supply heavy damping the cone movement as a check n cone overshoot and ringing, when xcited by heavy and sudden bursts f power.

RANSIENT RESPONSE

This ability to accelerate rapidly full amplitude and to stop just s instantly when excitation is reoved, is important with all speakers nd results in what is known as good ransient response.

Considering now the requirements or a good middle or high frequency peaker we find a very different state f affairs. First and foremost, when eproducing these higher frequencies he cone movement, although very nuch more rapid, is of almost microcopic amplitude.

The cone, therefore, while it should still be stiff enough to avoid breakup, must be very much smaller and ighter, otherwise its mass will prevent it from vibrating at the required speeds.

Its suspension does not require the same looseness because of the small cone movement, although it is often claimed that flexible suspension at the periphery is still an advantage to avoid undue damping of the cone movement.

The magnet structure should still provide a highly concentrated field but, because the voice coil is small, again to keep its mass low, the magnet need not be a very large one.

Lightness of the voice coil is so important that many middle and high frequency speakers have coils wound with aluminium wire instead of copper wire.

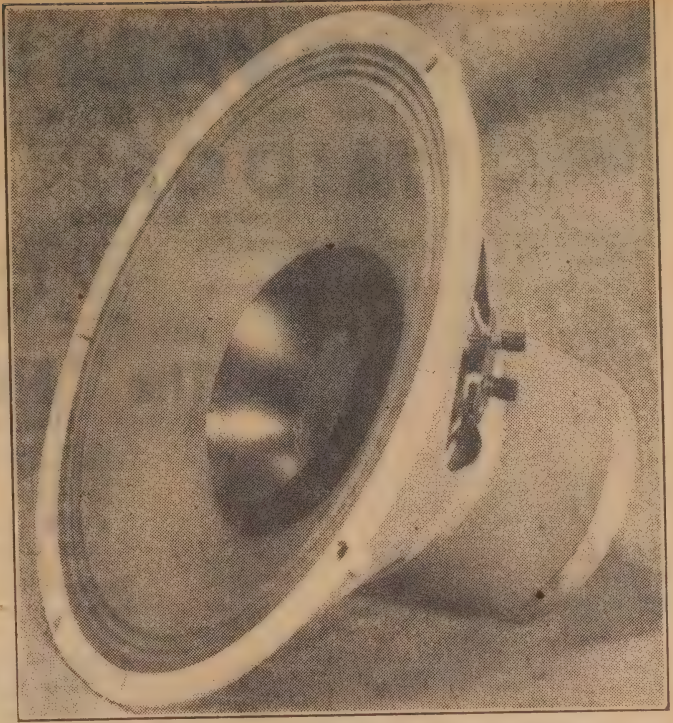
SINGLE UNITS

Incidentally, aluminium voice coils are sometimes found in high quality woofers, although their advantages are not so apparent with a big cone.

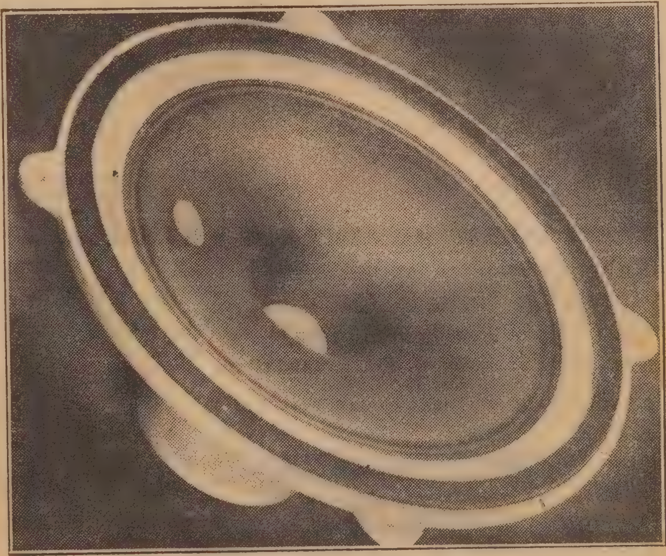
From this brief analysis of speaker requirements, not a complete one by any means, it is fairly obvious that a single cone cannot satisfy all requirements though, as we stated earlier, some of the better quality single speakers are remarkably good.

A wide-range single speaker must obviously be designed to operate efficiently as a bass speaker. The cone must therefore be as stiff as possible to prevent break-up and doubling in what is known as its "piston" range, the range in which it should move in one piece.

As the frequency rises, however, there comes a period in which the



The Goodmans speaker is a famous example of two cones cemented to a single voice coil for extended range. This construction poses many problems but allows a very good speaker to be made in quantity at a reasonable price. Note the large magnet for high efficiency and improved transient response.



This Baker speaker has a small cone, deeply curved for rigidity, and with soft outer suspension to help achieve a low frequency resonance. Note the inner section which has been treated to stiffen it. A small aluminium cap over the voice coil is a radiator at very high frequencies. A good example of the way in which full response must be tailored with a single cone.

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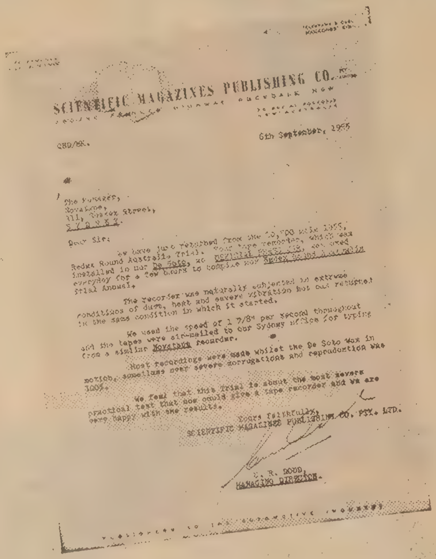

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I enclose LARGE self-addressed envelope and 6d in stamps e must begin to vibrate in sec- is. Soon we find that most of radiation is coming from the tre portion of the cone, where it stiffest. At extremely high fre- ncies, only the region close to voice coil, or possibly only the ce coil former itself, is radiating rgy.

t is at this point that the single aker begins to fall down in effi- ncy. Various devices are used extend its top range, either by fening the centre of the cone in effort to achieve better radiation by cementing small and very light ondary cones to the voice coil to ieve the same end.

Some manufacturers actually ke the cone in two pieces, joined gether about half way along its ameter by a compliant section.

The idea is that, at low frequen- s, the cone will still move in one ece. At high frequencies only the ntre portion will radiate, being oustically isolated from the heavier ter section by the compliant sec- n.

Another idea is to provide this mpliance right at the voice coil self, so that extremely rapid vibra- ns, corresponding to very high equencies, are not transmitted to e cone at all, but are radiated rgely by the voice coil cover sembly.

ONSTRUCTIONAL

The design of single cone speakers r full range is a study in itself d it is remarkable that such good sults can be obtained. By careful ntrol of mass, thickening the cone t certain sections and grinding it at thers, curving its contours, and so n, manufacturers have done an ex- ellent job, in many cases of avoid- ng the worst faults, and combin- ng the most essential requirements f design.

But despite their efforts, it is vir- ually impossible to avoid interfer- nce and intermodulation between he various frequencies being repro- uced at the same time, in a cone tructure which is not ideally suited o any of them.

This intermodulation is the main ause of muddiness and confusion when complex sounds are being reproduced, although the speaker may sound quite good when tested on single tones, or on music which does not involve a wide frequency band.

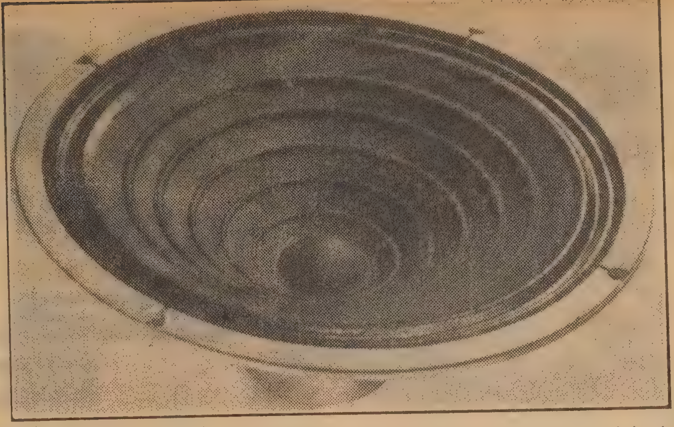
The important point about intermodulation is that it produces additional frequencies in the output which do not appear in the original sound.

INTERMODULATION

A speaker cone may reproduce a 200-cycle and a 2000-cycle note simultaneously without interaction. If intermodulation is present, however, additional sum and difference frequencies will be present at 1800 and 2200 cps.

Multiply this effect many times, as would be the case when a whole array of frequencies is being reproduced simultaneously and one can easily appreciate how such intermodulation can ruin reproduction.

It is the ability of a good single cone speaker to minimise this intermodulation effect which makes it sound so much cleaner than another of lesser quality. Cost is a big factor in the production of quality speakers, for mass production techniques are generally less successful than those which virtually demand individual assembly and test.



In this Rola 12-0 we note the softening of the outer suspension by special treatment to reduce resonance, the use of cone corrugations to control its behavior over a wide band and a dustcap which also radiates. This is a popular medium range speaker suitable for mass production.

The extremely complex relationship between the various modes and periods of vibration which occur in a speaker cone inevitably set up many resonant points in its response.

Even the best loudspeakers show sound pressure curves which are a virtual procession of such resonant peaks, some small and sharp, and others in the form of broad humps. One wonders when looking at them, that they can sound in any way acceptable.

ROOM EFFECTS

The fact that, when sound is projected into a room or a hall, it meets other and just as well defined peaks and resonances, is fortunate. The net result is to smooth out many of the speaker faults, so that speaker curves, although valuable in assessing the general character of the response, can not be taken as a complete guide to performance.

In fact, intermodulation and distortion effects in a speaker may even help to produce an output curve which looks better than one from a speaker free from these defects, for the microphones registering speaker output from a series of single tones invariably have a wide, flat response and record all the speaker output when energised in this way, including harmonics and spurious tones.

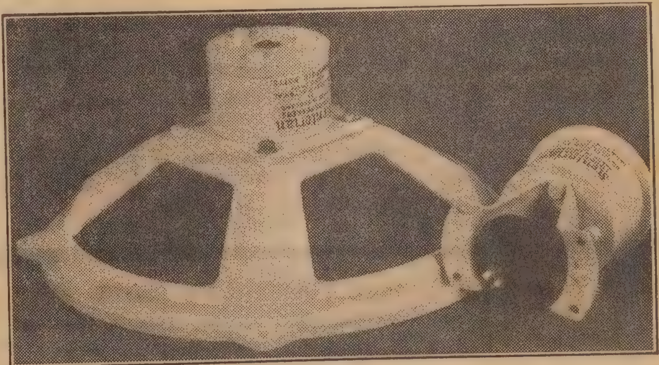
If the microphone were able to reject all the speaker output except the fundamental output of each single tone, the story would be vastly different.

This discussion highlights probably the two main advantages of multiple speaker operation. They are the extension of frequency response by using speakers designed to reproduce the low, middle and high range more efficiently than a single speaker, and the reduction of intermodulation distortion by specialised cone design and by a reduction in the frequency range each speaker is called upon to handle.

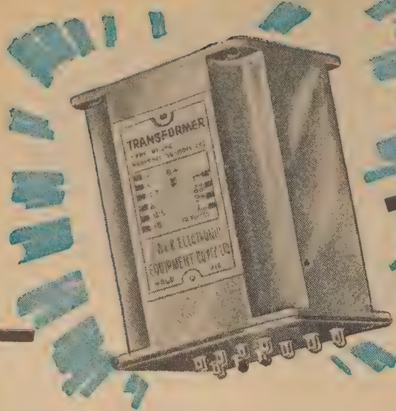
There is a third and very important advantage, and this is the removal of the "single source" effect.

The sound radiated by a single speaker must naturally come from one point—the speaker cone.

But very few sounds originate in this manner and, although we can



This Stentorian pair uses an impregnated cmabric cone in the LF unit which has a low resonance and is good up to the middle range. High frequencies are handled by a small pressure-type tweeter with a small dome-shaped metal diaphragm which radiates through small horn. A cross-over network is recommended.



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ver achieve the dispersal of a l orchestra, for instance, the dis-ution of sound between two or re speakers adds greatly to a ise of realism.

t also splits up the total sound essure between units instead of ncentrating it at one point, much the benefit of one's nervous sys-n and the achievement of greater axation in listening.

These advantages are present in multiple systems in which the eakers themselves are not mounted ncentrically. We shall mention ncentric or co-axial speakers again er on, but although there are me fine speakers which use this ethod of mounting units, they suc-ed more in saving space than in hieving better sound dispersal.

It is not always possible to take ll advantage of the dispersal fea-re of multiple speakers, which lls for some thought in grouping. t even the various radiograms w being produced, which mount eir speakers along the face of an dinary cabinet, are able to achieve me dispersal.

OUND DISPERSAL

It is obviously more apparent hen the second speaker covers the iddle and high bands, or when the me bands are split up between ree speakers, than in cases where e tweeter cuts in only at the higher and, and "rides on the top" of the rger unit.

Having physically separated our ultiple speaker system, there are ood reasons why we should separ-te them, at least substantially, in n electrical sense as well.

Although the speakers will have een designed to operate best over eir own particular frequency ands, there will still be some over-ap between them, in which both ill be delivering output signals hich may be either in or out of hase.

There is much debate about the mportance of this effect, particu-arly as room reflections are often onfused with phase interference at he sound source.

The cancellation of radiation by overlap by two speakers means that no radiation at all will take place from the speaker system at that frequency. Alternatively, if there is an additive effect due to phase re-nforcement, a peak of output will occur.

RANGE OVERLAP

It can only improve matters, therefore, to adopt some method of attenuating radiation from each speaker outside its own particular band, allowing enough overlap to ensure that no "holes" will be left in the net response.

This procedure is most important when the speakers are mounted fairly close together in the same plane and, furthermore, vitally affects only the low and middle speakers.

As regards the middle and high speakers, the wavelengths involved are so short when compared with the likely distance between the speakers that interference is comparatively unimportant, and largely uncontrollable.

Cross-over networks are often used in multiple speaker systems, and have the effect of attenuating the response above and below a certain critical frequency.

For instance, in a three-speaker system, a popular arrangement is to insert a network which will attentuate all frequencies from the low frequency speaker above about 800 cycles at the rate of 12 db per octave.

A second portion of the network attentuates all frequencies fed to the middle speaker below 800 cycles at about the same rate. The circuit may be so arranged that the total impedance presented to the amplifier over the full range being handled is not materially altered.

Should a third high band speaker be used, it is generally fed through a blocking condenser which gives some attentuation below its cross-over frequency of about 6000 cycles, or possibly a little higher.

USE OF NETWORKS

The use of the network has a valuable protective effect in that it prevents the middle and high frequency speakers from being fed with power at frequencies lower than they are designed to handle, and which could easily damage them.

This is perhaps the most important point of all, as the system might well be impracticable without it.

The mounting of multiple speakers in relation to each other is something which calls for careful thought.

On the whole, it seems best to make the most of the physical split, and to mount the speakers as far away from each other as is practicable without obviously dividing up the sound source.

In the case of a low and middle speaker, this might be as much as 2 feet or as little as 6 inches.

In the case of a low and middle in an enclosure, the middle speaker can well be placed on a small baffle board extending about 6 inches each side of the cone edge, or a small cabinet of corresponding proportion. A larger baffle is not needed in the region of 1000 cycles or so.

If a tweeter is used, it can be mounted at the side of the middle speaker, but not too far away from it.

SPEAKER MOUNTING

Because the higher frequencies tend to concentrate their radiation into a beam of a width which might be anything from 20 degrees to 45 degrees according to circumstances, it is often a good idea to mount the higher range speakers in a horizontal plane, or even facing one wall, to achieve maximum dispersal of radiation.

This does not result in a total loss of highs, as one might imagine, because a vast amount of reflection takes place at these frequencies which is probably the main characterestic of their journey through the room to your ear.

Co-axial mounting of two speaker systems is quite common, but there are serious disadvantages to the practice.

In the case of a small, open-backed speaker mounted in front of the woofer, it seems inevitable that, being in the direct path of the wave-front radiated at low frequencies, the smaller cone will be driven by the larger, thus reintroducing some of the intermodulation effects the twin-speaker system was devised to avoid.

There is also likely to be reflection of high frequencies from the larger cone, which can introduce phase distortion, again minimised by the two speaker set-up.

Interference between the two cones near the cross-over frequency is also a possibility, while the frame of the smaller speaker can interfere with radiation from the larger.

It seems best, therefore, to avoid this method of co-axial mounting.

SPECIAL CO-AXIALS

Some high-quality speakers, which use a separate voice coil assembly at the back of the larger speaker, and which radiate the higher frequencies through one or more horns, are probably free from most of these defects, but they still have the disadvantage of a single sound source.

It is probable, therefore, that given high-class units, a separated, multiple speaker system will always sound better than even a high grade co-axial speaker of comparable quality.

It is obvious that there is almost no end to the elaboration of loud speaker systems when striving for best possible results, but it is equally true that even modest arrangements can be very pleasant to the ear. It is impossible to consider a very high quality system without considering room acoustics as well, so that the material and financial cost may be high.

There is little point in going beyond the optimum requirements of any given amplifier and the room in which it operates.

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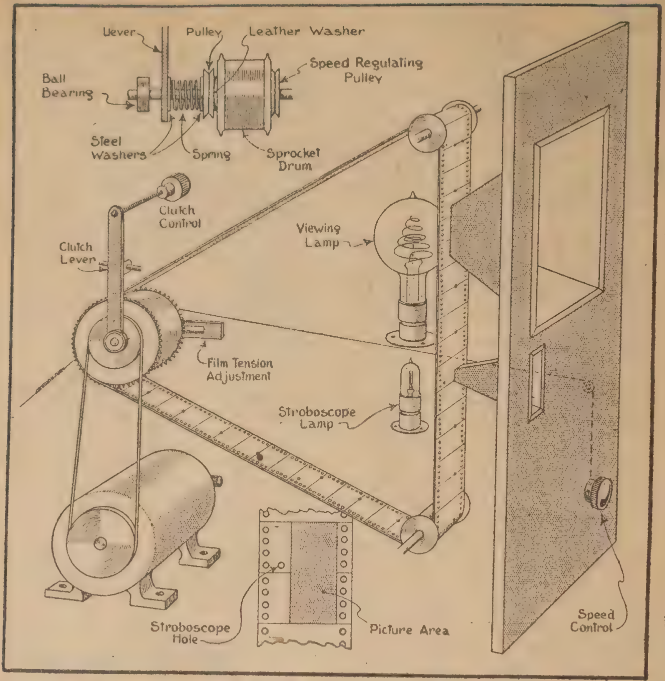

Figure 9: A television scanner suggested for home construction in 1934 Holes punched in the opaque film gave a 30-line vertical scan. The image seen through the viewing port was slightly smaller in area than a double 35mm., film frame.

A COURSE IN TELEVISION

PART TWO — PICTURE DEFINITION

Before going on to talk about cathode-ray tubes, as envisaged last month, it may be as well to examine some of the visual requirements which have to be met before a television image can be regarded as a satisfactory medium of entertainment. These requirements have a close bearing on the complexity of the equipment required to produce the image.

As might be imagined, the more ambitious the specifications set for a television picture, the more involved are the electrical problems associated with its production. The kind of picture seen nowadays on a television screen is only possible because the radio industry has become accustomed to working with components and circuitry far more complex than was originally envisaged.

But let's examine the matter more closely.

In our last issue, we drew an analogy between a television image and a half-tone printing block. We pointed out that, in both cases, the "picture" which the eye views is not a composite thing at all, but is made up from "bits and pieces"—a dot pattern in the case of a printing block and a line structure in the case of a television image.

The smaller the "bits and pieces" which compose the picture, the finer the detail which can be preserved for presentation to the eye.

It is not hard to appreciate that a printing block cannot reproduce detail, which is comparable in size with the dot or "screen" pattern itself.

The coarse-screen blocks, which have to be used in newspapers, are reasonably satisfactory for bold subjects but give a poor result when the subject matter is small or when detail is important. Pictures are sometimes rejected on this score, even though they might reproduce quite successfully in a magazine, using different paper and fine-scre blocks.

by *Neville Williams*

The same general limitatio apply to television. If a coar line structure is used, the syste is quite unsuitable for reproduci anything but very bold images, for example, the head and shou ders of a single person.

TYPICAL CASE

Because such a system lacks t ability to resolve detail, any attem to televise a group of people, o say, a complete orchestra, would r sult only in a meaningless blur i stead of a recognisable image the receiving end.

The earliest television systems, developed in Britain, operated wi about 30 scanning lines across t surface of the image. Results we extremely poor.

With a reproduced image about tw inches wide, divided into 30 line the width of each line had to b approximately 1-15th inch, bei produced by a scanning spot hav ing a diameter of about the sam figure.

Even assuming the most favo able conditions — a single perso televised full-face, close-up — th eyes would still only be compar able in size with the scanning spo and could only be reproduced a an indefinite blob.

If the face did not occupy th full screen area, the eyes woul scarcely appear at all.

MEANINGLESS BLUR

By way of illustration, the lines drawn across the photograph i figure 10 indicate the relative width of scan for a 30-line system. Wher it is appreciated that no detail inside the width of one scanning sector can be resolved, the force o the preceding paragraph will be apparent.

Though much mutilated by retouching and reproduction, figure 11 gives some idea of the kind of image obtained from early low-definition television equipment, actually about 60 lines.

PICTURES SHOW LIMITATION OF EARLY TV SYSTEM

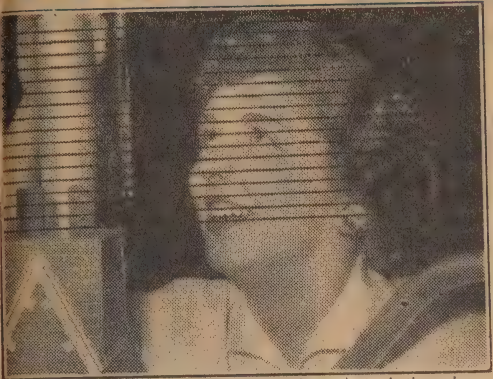

Figure 10: If this picture were to be televised through a 30 line system, it would be divided up as indicated by the black lines. No detail could be reproduced smaller than the division between the lines. Teeth, eyes, eyebrows, would all be too small to be resolved as more than a blob.

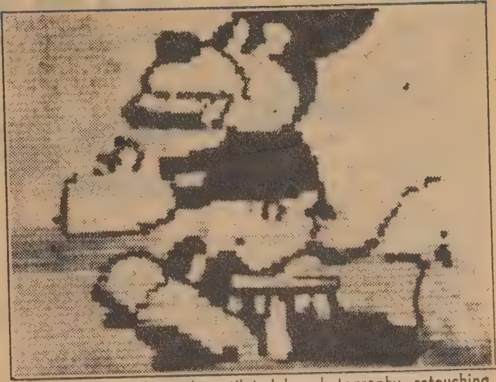

Figure 11: Though much mutilated by photography, retouching and printing, this gives some idea of the kind of image produced by an early low-definition system. Note how the coarse line structure gives a stepped effect to oblique lines. In most cases the image would be smaller than shown here, with poorer contrast.

It is certain that no television system operating on this basis could have any claim to entertainment value.

Neither is it surprising that the efforts of television experimenters were directed, very early, toward improving picture definition.

They realised that television could never be any more than a laboratory curiosity until the picture could bear at least some comparison with ordinary movies as an entertainment medium.

Though perhaps presented on a smaller scale, it had to be capable of resolving adequate detail, present an adequate range of tone and be free from jump and flicker.

HIGHER DEFINITION

The line structure was, therefore, pushed up progressively from 30 to 60, to 120, to 180 per picture, each increment improving the detail, but greatly complicating the associated mechanism. While it was a simple matter, for example, to locate 30 holes in a spiral pattern around the periphery of a disc, complication followed any attempt to double or quadruple the number.

Either the size of the disc had to be increased proportionately or the spacing between the holes reduced—and with it the possible dimensions of the complete image. Neither course was satisfactory, because the discs were already too cumbersome and the picture size needed to be increased, not reduced.

Other typese of scanning mechanism were evolved and developed to overcome this limitation, but, by and large, they all suffered the same basic objection in being too cumbersome and too noisy in operation for the quality of picture produced.

The same problem operated in reverse at the transmitting end, where mechanical means of scanning had to be employed to analyse the original scene and translate it into electrical signals.

It gradually became apparent that the only answer to the problem lay in the cathode-ray tube, which offered a means of picture analysis and presentation without the use of "machinery". The scanning sequence could be followed by the simple procedure of deflecting an electron beam across the face of the tube by means of an oscillating magnetic or electrostatic field.

There would be no whirring discs or drums to contend with, while picture size and brilliance would depend only on the development of larger and better cathode-ray tubes.

Of no lesser importance was the fact that an electron beam could be deflected with extreme rapidity, so that there would be no special problem in presenting a very large number of scanning lines in rapid sequence.

As it transpired, the substitution of electronic methods of picture analysis and presentation for the mechanical system made modern television feasible. The same basic ideas of scanning were retained, but on a more refined and precise basis.

The television system which has operated in Britain for many years

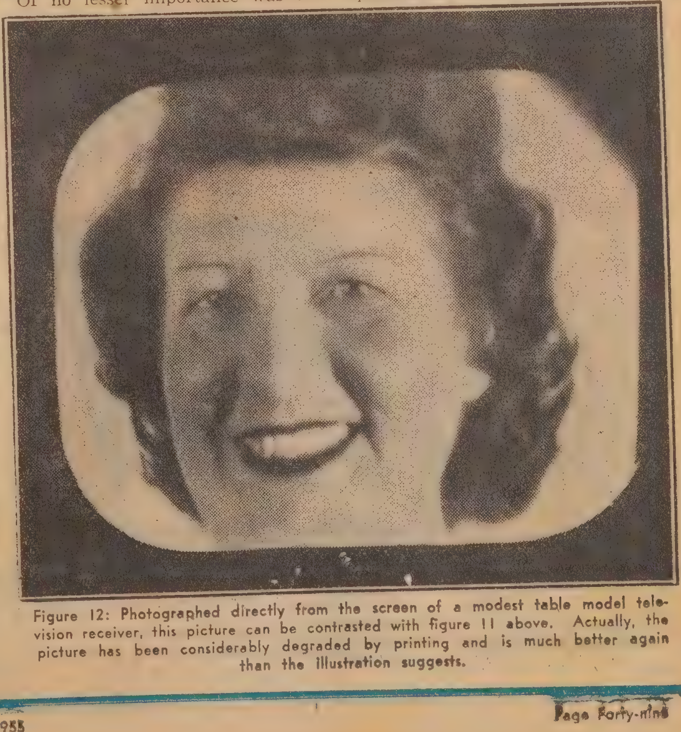

Figure 12: Photographed directly from the screen of a modest table model television receiver, this picture can be contrasted with figure 11 above. Actually, the picture has been considerably degraded by printing and is much better again than the illustration suggests.

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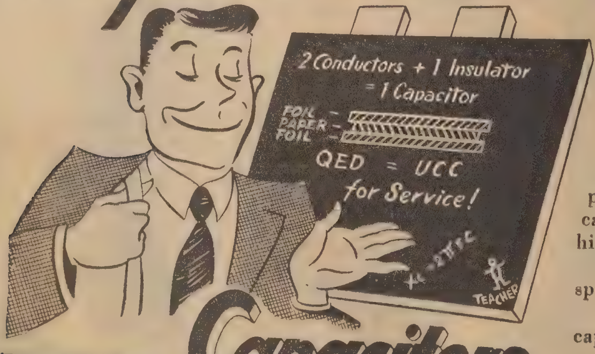

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es 405 lines and is, in fact, the dest and lowest definition standard current use. The US television stem uses a 525-line standard, while e Australian system is based on 5 lines.

In all cases, the line structure can ill be detected, if the picture is spected carefuly, but it is seldom parent under ordinary viewing conditions—on screens up to about 21 ches, measured diagonally, and ewed from about six feet.

DEQUATE DETAIL

Under the same conditions and on properly adjusted system the mount of detail available is comparable with what the average eye an resolve and is sufficient to allow he presentation of plays and items nvolving fairly large groups of eople.

Figure 12 is a reproduction of a icture taken by one of our own ameramen from the screen of a modest table model television receiver. The line structure is only vaguely discernible in the original print and is much finer than the printing block we must use to reproduce it.

In the original picture, individual wisps of hair, divisions between the teeth, highlights in the eyes are all clearly visible—a far cry from the limitations suggested by figures 10 and 11.

Just here, it may be as well to pause and explain the use of the word "standard" in an earlier paragraph, for the phrase "television standards" is a very common one nowadays in technical literature.

It will certainly occur quite frequently in this course and it is perhaps appropriate to introduce three or four of the more obvious standards which have to be determined when setting up a television service.

SAME SEQUENCE

A little thought will indicate that all receivers and transmitters in a given area must be designed to follow exactly the same scanning procedure so that, as the television camera analyses the original scene, the receivers will accept the resultant impulses and re-assemble the image in the same sequence.

Once having adopted a certain scanning procedure, it is not practical to change it for another, without suitably modifying all the transmitters and receivers concerned.

Amongst many other things, therefore, the television standards adopted by a country must nominate the number of lines in the picture, the direction in which the scanning proceeds and the shape of the picture.

Australian television standards specify a 625-line picture — over 20 times the number of lines used in early television experiments. The figure represents a fairly ambitious compromise between the ability of the system to resolve fine detail and the attendant complications of the associated circuitry.

We shall be examining this compromise between performance and circuit complication a little later in the series. Just now it must be taken for granted.

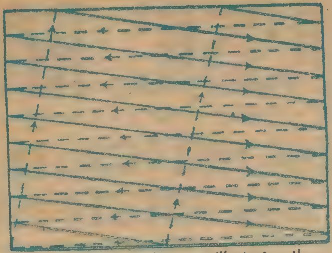

Figure 13: This diagram illustrates the path traced out by the scanning spot or beam for interlaced scanning. Compare this with figure 5, last month.

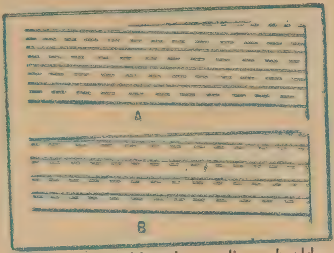

Figure 14: Odd and even lines should be spaced accurately for best results, as in A. Uneven spacing, as indicated in B, results in loss of definition. See illustration below.

The scanning sequence adopted as standard is from left to right for each individual line and progressing from top to bottom of the picture. In other words, the scanning spot follows the same general path as do the eyes when reading the page of a novel.

At the completion of each scan, the spot (or beam) reverts to the top left corner of the image to begin the process all over again.

The shape of the picture conforms to the same standard as a conventional movie frame. In more technical parlance it may be said that the "aspect ratio" — width to height — is as 4 is to 3.

Then there is the number of pictures (or scans) which are to be presented to the eyes of the viewer each second. On this figure, which might be described as the "picture repetition rate", depends the amount of flicker which is apparent in the image and the smoothness with which rapid movement can be portrayed.

Many readers will remember the flicker which was present in early movies and the way in which motor cars appeared to move across the screen in a series of tiny jumps. The explanation of both effects was in the presentation of too few pictures per second for the kind of scene being portrayed.

REPETITION RATE

As a general rule, a high picture repetition rate is an advantage but it produces difficulties in cinema practice and television alike. In the one case it involves the use of more film, in the other more complicated circuitry. The final choice is necessarily a compromise between these and other factors.

Sensitivity to flicker varies with individuals and also with the brightness of the image. Some people are much more sensitive to flicker than others, while it is always most apparent in a bright image.

Standard cinema practice nowadays is to photograph an original scene at the rate of 24 frames per second. When the film is exhibited, however, each frame is projected on to the screen twice, so that the patrons in the theatre actually view 48 pictures per second.

By and large, this is sufficient to avoid obvious flicker effects and to preserve smooth movement across the picture area. Difficulties which might arise due to massive highlights or extremely rapid movement are usually anticipated during production by proper choice or lighting, camera angles, &c.

MINIMUM FIGURE

Naturally enough, the same basic factors apply in a television system and a picture repetition rate of no less than 48 is indicated. Here again the advantage of the electronic method is apparent because the required rate can be achieved without resource to mechanical gadgets operating at very high peripheral speeds.

In actual fact, both the British and the Australian television systems have been designed to operate at 50

(Continued on Page 73)

Figure 15: This is a sector from a TV image photographed off the screen of a picture tube. The space between alternate lines is quite blank giving the effect of a very coarse line structure. More accurate interlacing would fill the spaces and give a result no different from figure 12.

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CONVERSION TYPE DC AMPLIFIERS

Drift and instability are ever-present problems in the design of amplifiers to boost small DC potentials. This article by Aerovox engineers describes the operation of conversion type amplifiers—those in which the DC potentials are modulated into AC, amplified by conventional circuits, then recovered from a detector.

OVER the years various conversion-type amplifier circuits have been developed.

In these arrangements, illustrated by the block diagram of figure 1, the DC to be amplified is applied first to a DC-AC converter. An AC excitation voltage also is applied to the converter. The converter output is an AC having the same frequency as that of the excitation voltage but with an amplitude which is proportional to that of the applied DC.

This output signal from the converter then is applied to a conventional AC amplifier which can be made quite stable by conventional techniques. Both voltage gain and power gain may be provided by this amplifier. The voltage gain is chosen to give the desired signal set-up ratio and the output power is selected for efficient driving of the output device. Rectification of the amplifier output recovers the DC. Thus, the DC input signal effectively is amplified by a system which partakes of the high stability of the AC amplifier.

USE OF AMPLIFIERS

Conversion-type DC amplifiers presently are in use in science and industry to amplify the tiny DC output of such devices as strain gauges, thermocouples, self-generating photocells, accelerometers, Ph meters and moisture sensers.

These amplifiers may be employed to actuate either recording or indicating instruments or electromechanical control devices.

Various types of DC-AC converters are employed in conjunction with conventional AC amplifiers. The representative ones are described in this article.

The AC excitation voltage may be derived from the tube-filament circuit of the amplifier section or may be supplied from a separate source.

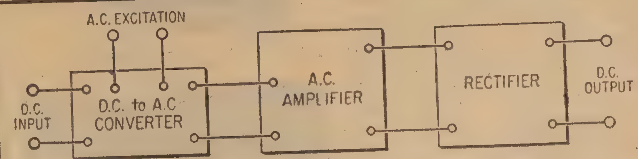
The excitation frequency sets the minimum transient response time of the system. For this reason the filament-source frequency often is too low to be useful, and excitation must be obtained from some higher-frequency source.

RESPONSE TIME

Response time also depends upon the time constants of the various coupling networks within the system.

The amplifier section may utilise a standard audio circuit (either RC or transformer-coupled) for use at excitation frequencies between 20 and 20,000 cycles, but must be a radio-frequency amplifier when extremely rapid DC fluctuations must be accommodated and the excitation frequency accordingly must be extended into the kilocycle or megacycle region.

The amplifier design is simplified, however, by the fact that this unit is essentially single-frequency in operation.



BASIC ARRANGEMENT OF CONVERTER-TYPE D.C. AMPLIFIER

FIG. 1

After AC amplification the signal is rectified. The rectified section may take any one of the several conventional forms—from simple half-wave to voltage multiplication. Also, the rectifier may be transformer-coupled or capacitance-coupled to the amplifier output.

Figures 2 to 7 show full-wave bridge rectifiers for illustration. When non-pulsating DC output is desired the rectifier output may be filtered with either RC or LC networks.

Figures 2 to 7 show various arrangements for conversion-type amplifiers. These will be described separately.

Figure 2 shows the arrangement which perhaps is in widest use at the time of this writing.

The converter is a "full-wave" vibrator which chops the applied DC into pulses of current which flow through the primary winding of the input transformer. The resulting AC voltage developed across the secondary of this transformer is applied to the input of the AC amplifier.

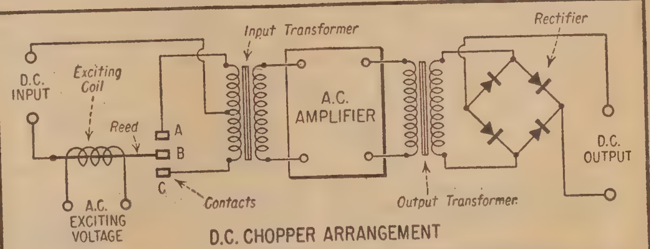
Basically, the chopper unit consists of a thin iron or steel reed securely fastened at one end and provided with a contact (B) on its free-swinging end.

EXCITATION COIL

A coil, usually containing many turns of fine wire, surrounds a portion of the reed, but does not touch it, and is supplied with alternating current from an excitation source.

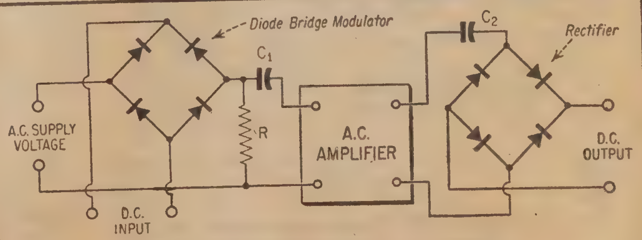
The alternating magnetic field due to this excitation current sets the reed into vibration, causing contact B to swing alternately between contacts A and C. This action switches the direct current alternately through the upper and lower halves of the input-transformer primary.

This is a rudimentary type of chopper, as shown here, and serves only



D.C. CHOPPER ARRANGEMENT

FIG. 2



DIODE-BRIDGE MODULATOR AS CONVERTER

FIG. 3

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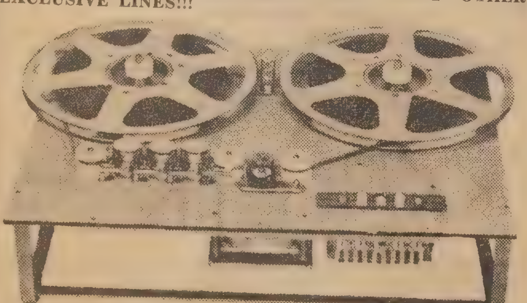

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illustrate the principle. Many re-nements are incorporated into com-ercial chopper-type converters to nsure stability and long operating fe.

Some converters are driven from second DC source, instead of being xcited with AC in such a way as to ause self-vibration often at rates uch as 400, 800, and 1000 cycles.

The chopper-type converter has the disadvantage that it contains moving parts and make-and-break contact. These factors sometimes act to limit ts life; and, in some instances, make necessary special provisions for mechanical noise silencing, spark suppression, and vibration damping.

Its advantages are comparatively small size, simplicity and the complete absence of an output signal unless a DC is applied.

DIODE-BRIDGE MODULATOR

The semi-conductor diode-bridge modulator, normally used with two AC signals, can be employed as a DC-AC converter by substituting a DC input for one of the AC signals.

The AC excitation voltage may be derived from the filament circuit of the AC amplifier, with which the converter is used, or from a separate source.

This simple device (see Figure 3) delivers an AC output, which has the same frequency as the excitation source and an amplitude proportional to that of the DC signal. The AC output voltage may be developed across a resistor, R, as in Figure 3, and coupled through a capacitor, C, into the AC amplifier.

Or, for isolation, a coupling transformer may be used between the diode bridge and the amplifier input.

The bridge modulator may be regarded as a type of electronic switch, in which the AC excitation current cycles turn the applied DC on and off.

This action is accomplished through the polarity-sensitivity of the diodes, each pair of which conducts on alternate half-cycles of excitation. On one half-cycle, the effect is to open the path between the DC input and the AC amplifier; on the other half-cycle, the path is closed. Thus, the on-off action.

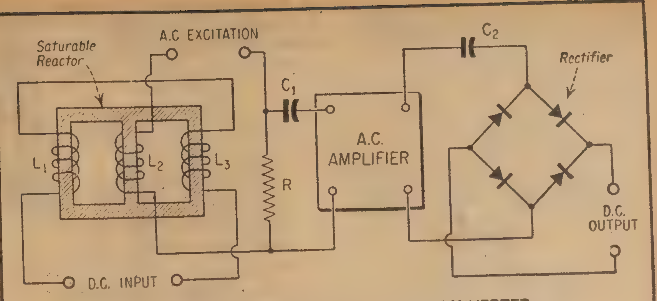
This type of converter can be made with diodes of either copper oxide, germanium, silicon, or selenium types. The germanium and silicon units have the advantage of providing operation up to high radio frequencies, while the upper operating limit of copper oxide is 5 to 10 kc. and that of small selenium diodes about 50 kc.

All four diodes in the modulator bridge must be closely matched. Single 4-diode assemblies (known by various manufacturers as quads or varistors) are available with matched EI characteristics in germanium and silicon.

The modulator-bridge type of converter has the advantages of very small size, light weight, long life, high-frequency capability and simplicity. Its disadvantages are temperature sensitivity and non-linearity at low current levels. The latter feature often necessitates special calibration of the entire amplifier system using this converter.

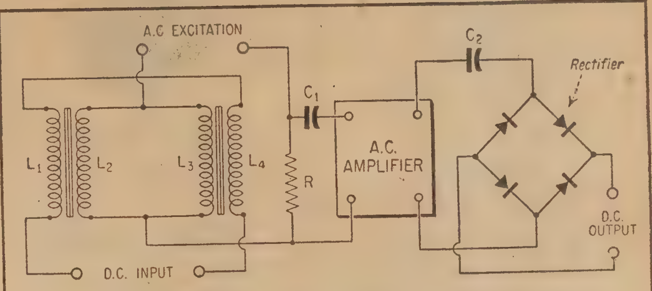
SATURABLE REACTOR

The magnetic-type converter illustrated in Figure 4 is one of a class of magnetic amplifier devices.



3-LEGGED SATURABLE REACTOR AS CONVERTER

FIG. 4



2-TRANSFORMER SATURABLE REACTOR AS CONVERTER

FIG. 5

Operation of this DC-AC converter is based upon core saturability.

The input DC flowing through one coil of a controllable reactor causes core saturation in varying degrees proportional to the current strength. This saturation changes the inductance, and thereby the impedance, of a second coil wound on the same core.

AC excitation current flowing through this latter coil is controlled by the varying impedance, and the AC delivered by the converter accordingly is proportional to the applied DC.

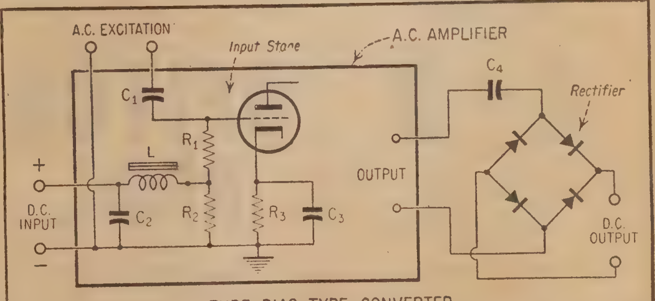
The AC and DC coils are wound on a 3-legged core in Figure 3 in an arrangement which prevents the flow of alternating current in the DC coil. This is accomplished by separating the DC coil into two halves, L1 and L3, and connecting these two halves to buck. Thus, any AC voltage induced in L1 by alternating current flowing in the AC winding (L2) will be bucked out by an equal and opposite voltage induced in L3. Therefore, no AC appears at the DC INPUT terminals.

Converter-output AC flows through resistor R across which it sets up a voltage drop. The signal is coupled from this resistor, through capacitor C1, into the AC amplifier channel. Transformer coupling also can be employed.

Like the diode modulator, the magnetic-amplifier type of converter has the advantage of freedom from moving parts. It is simple and compact, can be made small in size, and has no life limitation. Its only disadvantages are restricted response time and its low frequency characteristic (limited by the core characteristics to audio frequencies).

TRANSFORMER-REACTOR

Figure 5 shows another magnetic-type converter. This arrangement employs two small-sized audio transformers which have cores capable of DC saturation. L1 and L4 are prim-



TUBE-BIAS-TYPE CONVERTER

FIG. 6

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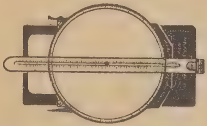

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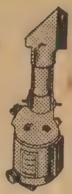

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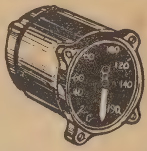

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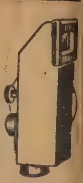

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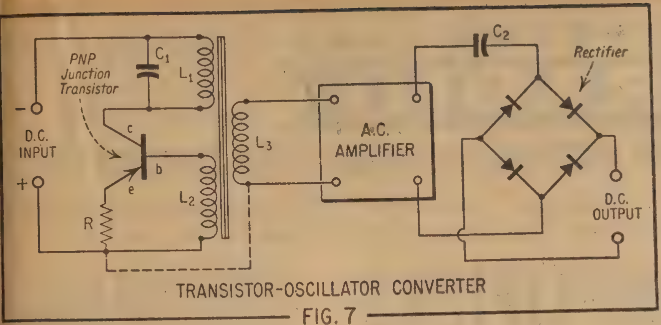

TRANSISTOR-OSCILLATOR CONVERTER

FIG. 7

ary windings (lesser number of turns), while L2 and L3 are secondaries (greater number of turns).

The secondaries are connected to buck, so that any AC induced in one by alternating current flowing through the paralleled primary windings (L2 and L3) will be cancelled by an identical AC induced in the other. In this way, no AC appears at the DC INPUT terminals.

This converter operates in the same general manner as the one shown in Figure 4. That is, the direct current flowing in L1 and L2 causes varying amounts of core saturation and thus alters the impedance of the AC windings L2 and L3. This action causes a variation of alternating excitation current flowing through L2-L3 and resistor R. The AC signal voltage across R thus is proportional to the applied DC.

The converter-output AC signal voltage is coupled through capacitor C1, into the AC amplifier channel. Transformer coupling also can be employed with somewhat greater complexity.

The advantages and limitations of this converter are identical with those of the unit shown in Figure 4 and described in the preceding section.

TUBE BIAS CONVERTER

The DC signal to be amplified may be employed to vary the control grid bias of the input stage of the AC amplifier section and thereby to yield an AC output voltage proportional to the applied DC. The AC amplifier is assumed to be transmitting a signal derived from the AC excitation source. This scheme is illustrated in Figure 6.

Here, the major amount of bias is developed by the input-stage cathode resistor, R3. The DC input signal voltage is applied across R2 in series with the self bias of the tube. AC excitation voltage is applied through coupling capacitor C1. The filter network, LC2, prevents this AC from reaching the DC INPUT terminals.

The AC excitation is a constant voltage, usually of millivolt level. As the DC input signal varies, the grid bias is shifted, and amplification of the excitation signal varies proportionately.

This system has the advantage of relative simplicity. It may be applied readily to an existing AC amplifier, occasioning few circuit alterations. It requires some care, however, in the selection of the static bias level, in order that changes resulting from input DC signal fluctuations might produce linear variations in AC output amplitude over a desired range. A particular advantage of this system is its adaptibility to RF as well as AF amplifiers. At radio frequencies, rapid fluctuations in the DC input signal can be followed. In this case, the AC excitation voltage would be supplied by a radio-frequency generator.

TRANSISTOR CONVERTER

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(Continued on Page 127)

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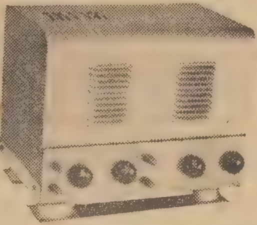

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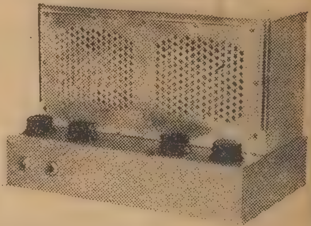

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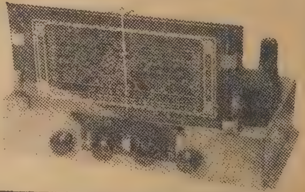

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A READER BUILT IT!

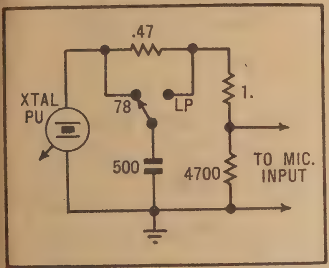
Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

TWO CIRCUITS FOR TAPE RECORDER ENTHUSIASTS

Submitted by Mr. H. Swan, Bulimba Hostel, Brisbane Street, Bulimba, Brisbane, Queensland are two circuits of interest to tape recorder enthusiasts.

THESE circuits are intended for use with recorders which have only microphone input terminals and are not fitted with radio tuners.

The first circuit is a combined attenuator and compensator pad for feeding a crystal pickup into the recorder. It has both 78 and 33 positions and our reader suggests that it should be built into a completely screened box to prevent hum pickup.

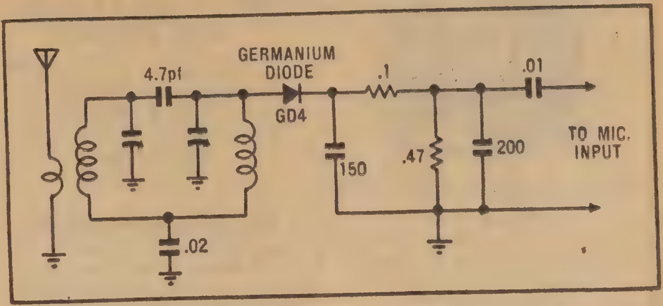


This idea could well be extended to include compensating networks for any type of pickup, or to make up small deficiencies in the recorder.

The second circuit is of a crystal tuner unit using a germanium diode, the aerial circuit is a bandpass circuit and should give good results. From our reader's experience with this circuit he has only had trouble with one strong local station and intends using a wave trap to eliminate this trouble.

Two standard aerial coils could be used for the bandpass circuit with the primary of the second one removed.

The germanium diode used is the high resistance type GD4, which does not require a heater supply and can be wired in the circuit as easily as a resistor.



No doubt many of our readers will build this circuit, as it will give reception of strong local signals and does not call for expensive components. A further advantage is that no modifications are necessary to the internal wiring of the recorder, neither is additional power required from the recorder.

ANY BRIGHT IDEAS?

This page is for you, the reader, to present your ideas to all interested in radio and allied subjects. If you have an idea, put pen or pencil to paper and let us have it for possible use in this page.

WORKSHOP TELEPHONE CIRCUIT

This month we have a circuit of a two way telephone system which has been forwarded to us by Mr. J. G. Joyce, 48 Gascoyne Street, Launceston, Tasmania. It follows on a previous circuit that we printed in this section in January, 1955.

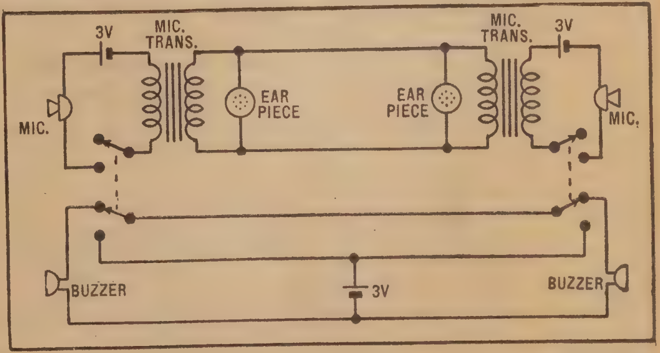
THE circuit uses two spring type PMG lever switches, which are operated when the phone is removed from its stand, and the actual mechanical set-up is left to the individual.

The drawing of the circuit shows both the switches in the at rest position. When one of the hand sets is lifted its battery is connected to its microphone by one section of the switch.

The other switch section connects the common battery to the buzzer at the other end. This buzzer will continue to operate until the other phone is lifted from its hook.

Although this circuit requires a five wire cable between the two points it does avoid the need to manually reset the call switch.

Our reader has had this system in operation for over four years and the original three-volt cycle lamp batteries are still in use. All the other components came from disposal sources and the whole system has been very satisfactory.



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12V	500V	350MA	8 10 0
12V	1200V	200MA	6 10 0
6V	500V	150MA	6 10 0

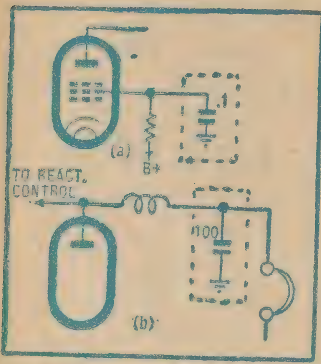
Here's your answer, Tom!

RF and screen bypass capacitors, neon-lights, microphones and coils make up the subject of this month's article. Among them is a question which has the dubious distinction of getting the shortest answer ever published in these columns.

There's no point in wasting time, so let's get on with the questions. Here's the first one:

I have noticed that in many circuits you have shown a capacitor from one of the grids or from the plate to earth. What is this capacitor and why is it there?

We have no doubt, Tom, that this question has baffled many a budding expert.



Illustrating (a) a screen bypass capacitor and (b) a plate bypass.

Before we start explaining, however, we'd better get the two things separate in our minds.

As often as not, Tom, you will find that the two capacitors mentioned are widely different in value. This is because they have two different jobs to do. The capacitor connected to "one of the grids" is usually called the screen bypass capacitor, while the one connected to the plate is an RF bypass capacitor.

In order to understand the function of the screen bypass we have to consider what the screen or screen grid actually does in a valve.

The story started when it was found that there was too much capacitance between the control grid and the anode of a triode valve. This was of not much consequence while only audio frequencies were involved but resulted in instability when radio frequencies were involved.

The obvious solution was to place a shield between these two electrodes which would reduce the capacitance but at the same time permit the electron stream to pass. This was done easily enough by inserting another grid, but if this grid was kept at earth potential it repelled more electrons than it let through and the plate current of the valve was drastically reduced.

Connecting the screen to a source of positive high tension eliminated this difficulty but introduced others. Being connected to a positive voltage, this grid drew current, and to limit this (and also to regulate the screen voltage), a resistor usually has to be connected in the screen circuit.

This resistor, however, acts as a load resistor and with the current varying with signal through the valve, considerable voltage variations appear on the screen. But these variations defeat the whole purpose of placing a neutral electrode in the electron path as a shield.

BYPASS CAPACITOR

This is where the screen bypass capacitor comes into the picture. We have mentioned that the screen must be neutral as far as the signal being amplified is concerned. This signal will invariably be an AC signal. As a capacitor presents a virtual short circuit to AC, provided it is made big enough, any signal voltage appearing on the screen can be bypassed to ground by connecting a capacitor between the screen and earth.

Alternatively one might regard it as a storage capacitor which is charged to the average potential of the screen. Though the screen current may rise during each positive half-cycle of signal the time interval is too short to discharge the capacitor appreciatively. Similarly a periodic decrease in screen current at the signal frequency represents far too brief a period for the capacitor to acquire any additional charge. The average screen potential therefore remains constant.

In domestic receivers a screen bypass value of 0.1 mfd is commonly employed, having a sufficiently low reactance or an adequate storage effect—whichever way you choose to look at it.

In valves primarily designed for audio amplifiers the shielding action of the screen is of no great consequence, as the capacitive impedance between grid and plate is sufficiently high to prevent any instability from occurring, at least at the frequencies involved.

However it was found that the screen, besides having a shielding action, also considerably increases the speed of electrons flowing through the valve. This is because it is connected to a high positive voltage and thus attracts electrons. Being in the form of a grid, however, only a few electrons strike it, the rest being carried on by their momentum to the plate.

However, to make full use of this feature the screeen voltage must be kept constant and it must not vary with the signal voltage. Therefore it still has to be by-passed, with even higher values of capacitance than for RF. Values as high as .5 mfd are not exceptional in audio amplifiers.

The bypass keeps the screen voltage steady, so that the signal at the plate is primarily dependent on the grid signal and not on a varying screen potential as well.

Coming to figure (b) you will most likely have noticed, Tom, that this capacitor has a much smaller value than a screen bypass.

Its main purpose is to prevent any radio frequency current which may have got past the RF choke from getting any farther, in this case into the headphone lead.

"Shout, Tom . . . !"

As you know, Tom, one-valve reaction sets are very finicking things to tune and to keep tuned. The RF choke and the capacitor in question (an RF bypass capacitor) are included in the lead to the headphone to prevent RF from getting away from the plate by any other route than via the reaction capacitor and coil.

The reaction is mostly controlled by allowing more or less RF current to flow to earth through the reaction coil via the reaction control capacitor. If the headphone lead was not separated from the plate of the valve

F would get into it and from there) earth via the capacitance of your ead or your hands. As this capaciance varies greatly with any moveient the reaction would be altered nuch in the same way as if you hange the reaction control.

This is often called "hand capacity" ffect. It makes the reaction behave ery erratically with any movement f the head or hands, making listenng almost impossible. The RF choke revents most of the radio frequenies from getting away, and any stray RF is short-circuited to earth by the apacitor.

Having thus disposed of problems f bypassing we can turn our attenion to a question which, on the surace, appears to be quite straightforward.

NEON SIGNS

How do neon signs work? And can you tell me what makes them flash?

Atoms are the favorite subject of conversation these days, Tom, so it couldn't hurt if we talk about them a little, either. Why? Because the way neon signs work depends on the way gas atoms behave in a very strong electric field.

The basic neon tube consists of a glass tube bent to the required shape and evacuated. Two electrodes are sealed into the ends and a small amount of gas, usually neon, is allowed into the tube.

The complete sign consists largely of a metal support for the various letters, and inside it there is a transformer delivering anything up to 25,000 volts. Depending on the length of the tubes, they may be connected to the transformer in series, or parallel, or both.

The actual voltage applied to any tube depends primarily on its length.

Owing to the high applied voltage and the small area of the electrodes an immensely strong electric field is set up between the two ends of the tube. It is so strong, in fact, that electrons are stripped off the metal atoms in the electrodes and projected out into the tube.

GAS IN TUBE

If the tube were completely evacuated nothing would happen except that the electrons would fly through the vacuum and land on the opposite electrode, possibly heating it slightly.

But the tube is not quite empty. It has a small quantity of neon gas in it. The electrons fly through the tube at high speed and collide with the neon atoms, knocking electrons off them.

And here we have arrived at the gates of atomic science. For the fast-moving electrons have high kinetic energy. Some of it will, of course, be imparted to the electrons knocked away from the nucleus of the atom, but the rest of the energy is transferred to the nucleus and the remaining electrons. However, it cannot stay there and something has to happen to it.

So the atom which, having lost some of its electrons, should actually be called an ion, releases this surplus energy of collision in the form of a quantity, or quantum, of light.

Although we have singled out one atom the same thing happens to most gas atoms in the tube, so that there is a continuous emission of light from it whenever there is a voltage applied to the electrodes.

And the flashing effect? Well, Tom, that is done simply by having the neon sign turned on and off at regular intervals by a small clockwork motor or an automatic time delay switch, not unlike the heat control on your better half's automatic electric iron.

And so for the next question.

I am using a headphone for a microphone. How can I increase the volume on the receiving end without using an amplifier?

Shout, Tom!

Somebody just suggested in the background that this explanation is not helpful enough. Can anyone suggest a more practical one?

What is the inductance of a coil? Has it anything to do with the value in henries of a coil. And what are millihenries?

To answer this question, Tom, it is necessary to recall a few basic facts about magnetic fields.

In the first place it is necessary to remember that, if a magnetic field around a coil is in a state of motion (that is either building up or collapsing), then it will induce a current in the coil.

REVERSE IS TRUE

The reverse is also true, in that the passage of current through a coil builds up a magnetic field around it.

The two effects are inseparable, and go on simultaneously. Let's see what this means in practice, Tom.

If we try to pass a current through a coil, its immediate effect is to build up a magnetic field around the coil. In other words, the initial flow of current is accompanied by an expanding (therefore a moving) magnetic field.

This moving magnetic field, in turn, induces its own current through the coil and it so happens that this induced current is opposite in direction to the one we initially tried to pass through the coil.

If we now interrupt the initial current, the magnetic field it produced then begins to collapse. This movement of the field causes an induced current which again opposes the initial current. Whereas we are trying to terminate the initial current, the induced current tries to keep it flowing!

This may or may not be clear to you, Tom, but the important point to grasp is that the action of the magnetic field around a coil is always to OPPOSE ANY CHANGE in the current flowing through the coil.

OPPOSES ANY CHANGE

If there is no current to begin with, then the coil opposes any attempt to initiate one through it.

Conversely, if a current has been established, then the coil opposes any attempt to reduce or reverse the said current.

One might almost think, Tom, that coils were invented in Ireland!

The whole effect becomes most apparent when an alternating current is passed through a coil, because an alternating current is one which is constantly changing its value and direction. A coil, therefore, opposes the flow of "AC" through it to a greater degree than

(Continued on Page 118)

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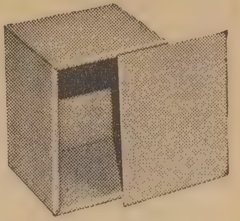

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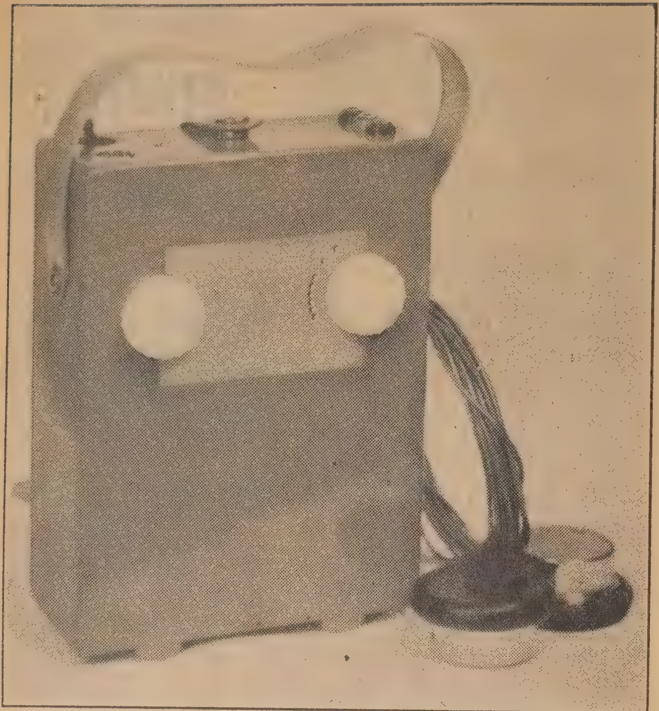


The completed receiver is housed on a small, easy-to-handle carrying case. Note the aerial and earth terminals on the top right and the filament switch and phone jack on the top left. The headphones and a length of aerial wire are the only accessories needed to put it into operation.

A SIMPLE SET FOR BEGINNERS

Here is a set which is ideally suited to our younger readers. Not only will it provide good fun and experience in the building process but the finished job is an ideal companion for your hikes and camping expeditions. With the advent of summer there should be plenty of use for such a set.

by Philip Watson

OUR original inspiration for this set came in the form of a larger than usual influx of letters from our younger readers. It seems that, no matter how many times we describe the small sets, which are so popular with the beginners, there is always someone who is just starting and needs the step-by-step instruction. Added to this are those who invariably want their small set in some form which differs from those already published.

NO OPTION

When these demands become as insistent as they have over the past few weeks, we have little option but to knuckle down and produce another small set and incorporate as many of our readers' and our own ideas as possible. This set is one attempt to satisfy these demands.

We have called it "Little Jim for 1955". Many of our older readers will remember the original "Little Jim" series which were so popular some years ago. Some may even query whether this set really qualifies as one of this type, since all of this series so far have been built around a twin triode, either battery or AC type.

We considered this point when we set out to design our latest version and realised we might have to change our ideas. In the days of the first "Little Jim", battery twin triodes were quite popular, being used in class B output stages of full-size receivers. We were able to "cash in" on this popularity and use such valves in less conventional circuits.

But fashions change, and class B battery sets are no longer popular. As a result, while more efficient and more economical versions of other valve types have been developed over the years, battery twin-triodes are still only available in the types which we used originally.

BREAK WITH TRADITION

In the face of this it seemed silly to bind ourselves to such a valve when better performance and greater economy could be obtained by breaking with tradition and employing two modern high-performance valves. In this case, we chose a pair of 1T4's, a battery pentode capable of very good performance and low battery drain in a small set.

In other respects, the circuit follows the same general lines as the earlier versions. A regenerative detector, a stage of audio amplification, moderate HT voltage, headphone operation, and so on.

This "Little Jim" is intended mainly as a simple portable. It is small enough to carry on a hike or camping expedition, yet sensitive enough to provide useful reception in most localities. Admittedly, it will be necessary to improvise some form of aerial (such as a length of insulated wire tossed over a convenient branch), and reception is limited to headphone operation, but these factors are hardly likely to dampen the enthusiasm of our younger readers.

ALWAYS A THRILL

On the contrary, most will get quite a kick out of setting up the gear, while each pair of headphones, shared in the time-honored manner, will provide entertainment for two people.

The set is also quite economical to run. The HT current drain is only about three milliamps with a 90-volt battery, and less with lower voltages, on which, incidentally, it works quite well. In fact, it will work quite well on a 90 or 67.5-volt battery which has long passed its prime for service in a conventional portable. This means that if you can locate a source of such discarded batteries you will be able to provide HT power for virtually nothing.

To prove this point, we conducted most of our tests with a discarded 90-volt battery which could muster only 50 volts on load. All the indications were that it would continue to function for a long time yet.

We investigated many possible designs before settling for the one shown. We had ideas about transformer coupling or choke coupling in order to permit operation from a nine-volt HT battery. This idea was not altogether a failure, but it did render the design of the coil quite critical, so much so that it would not have been possible to use the design with all available coils.

SCARCITY

In addition, there was the problem of finding a suitable transformer or choke, which would be readily available and which could also be accommodated without making things too bulky. Such a unit appears to be virtually non-existent at the moment and we were finally forced to the conclusion that a reversion to resistance coupling, along with a larger HT voltage, was the only reasonable solution.

We also tried a midget coil, which is available in at least one brand, but its performance, compared with the larger types, was not impressive. This is not the fault of the design, but simply what one would expect when any coil is scaled down to the midget dimensions. In larger sets the loss can usually be tolerated in the interest of compact design, but it seemed a backward step for a set of this kind. We accordingly settled for a standard type.

The final result is portrayed in the circuit and other diagrams on these pages. The circuit is a straightforward affair, but there are one or two points worthy of comment, which will help the beginner to understand what it is all about.

FILAMENT CIRCUIT

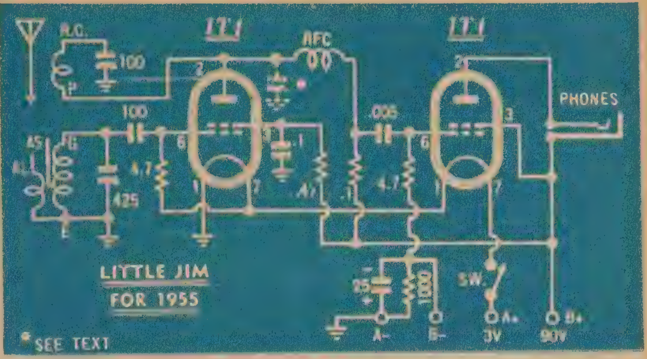
The 1T4 has a 1.5 volt filament, drawing 50 mA, and we could arrange for the two filaments to be connected either in parallel, so that they would operate from a single cell with a current drain of 100 mA, or in series requiring a three-volt battery delivering 50 mA.

We chose the latter arrangement for, although the power consumed is the same in both cases, there are other advantages. For one thing, most batteries are happier with the lower current drain and will generally deliver more power than if it were taken at a higher rate.

Also, by putting the second valve at the positive end of the filament network, we are able to use the voltage developed across the first valve as a bias for the second one. In some cases, this will be all the bias required and the cost of a couple of components will be saved. We will have more to say about this in a moment.

Finally, it makes possible the use of a two-cell cycle lamp battery of

CIRCUIT OF THE NEW LITTLE JIM



The circuit is quite a simple one and most beginners should be able to work from it, with perhaps a little help from the wiring diagram. Note the series filament circuit, the back bias network, and the capacitance shown dotted from the plate of the detector.

a type which is quite popular and available almost anywhere—an important point from the camper's point of view. This battery uses brass leaf contacts, which make possible a simple but effective mounting system which completes the necessary connections to the set automatically as the battery is slipped into place.

PARTS LIST

2 1T4 valves
2 7 pin miniature sockets.
1 Reinartz coil.
1 Single circuit phone jack with insulating washers.
1 SPST toggle switch.
18g aluminium for chassis and brackets.

CAPACITORS

1 25 mfd 25V electrolytic.
1 .1 mfd 200V paper.
1 .005 mfd 200V paper.
1 425 pf (approx.) midget tuning.
1 100 pf reaction capacitor.
1 100 pf ceramic.

RESISTORS

2 4.7 meg.
1 .1 "
1 .47 "
1 1000 ohm
All half watt size.
1 RF choke.
3 Tip jack sockets with bushes and lugs.
2 Tip jack plugs.
1 67.5 volt battery.
1 3 volt cycle lamp battery.
1 Pair of HT battery connectors
2 1¼in diameter knobs.
1 4 terminal tag strip.
3/16in and ⅜in plywood for cabinet.
2 Small brass hinges.
plastic strap.
press fastener.
nuts and bolts, solder lugs, hook-up wire bif. rivets etc.

As already mentioned, the bias derived from the filament network will be sufficient in some cases. In particular, this is so where the HT voltage is not likely to be above about 50 volts. Where the main source of HT is from discarded 67.5 volt batteries, the voltage will probably be of this order or lower, and the current drain should not exceed three milliamps.

However, a new 67.5 or 90 volt battery would increase the drain to five or six mills, which is heavier than desirable or even necessary, since the performance will not be improved. To offset this we fitted a back-bias network, consisting of a 1000 ohm resistor and a 25 mfd electrolytic capacitor, which limits the drain to about three mills at 90 volts.

This network becomes less effective as the voltage drops so that it will not prejudice performance with lower voltages, but will serve as a safeguard against excessive drain if a new battery is fitted. You can please yourself whether it is included or not. If it is to be omitted the 4.7 meg resistor and the B battery negative lead will both connect direct to the chassis.

ADJUSTING REGENERATION

The capacitor shown dotted from the plate of the detector will probably need to be selected experimentally, if it is needed at all. Its purpose is to control the amount of RF energy which is allowed to reach the reaction winding and associated controlling capacitor.

Since we are assuming a ready-made coil, we will have no control over the coupling between the reaction and grid windings, and this will vary somewhat from one make of coil to another. In all cases it should be adequate, but it can frequently be too great, making it impossible to control the regeneration even when the reaction capacitor is in the full-out position.

When this happens, fitting the small capacitor will divert some of the RF energy from the reaction circuit and allow it to become more manageable. A value around 50 or 100 pf will probably suffice, though it may need

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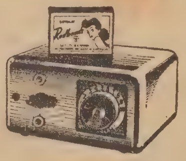

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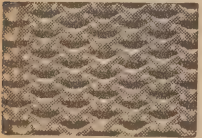

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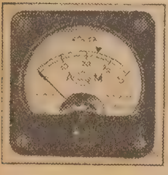

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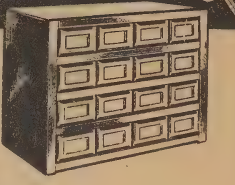

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to be greater in some cases. The value of the HT voltage will also effect it, a greater HT voltage causing more violent regeneration.

All the components used in the set are standard types which should be available from most radio dealers. The tuning capacitor is a midget single section type with a maximum capacitance of approximately 400 pf. Its exact value is not critical, but make sure that it will fit in the space allocated for it.

The reaction capacitor is 100 pf variable single hole mounting type, sometimes known as a 14-plate variety.

There are a number of suitable coils available in various brands and they should all work equally well. However, those types with a slug protruding from the top of the can may be a little too tall to accommodate without screwing the slug a long way in. In most cases this will not matter, since the coil does not need to track with any other, but it may cause some stations to be shifted off the end of the band and it may upset the intended amount of coupling between the various windings inside the coil.

FILAMENT SWITCH

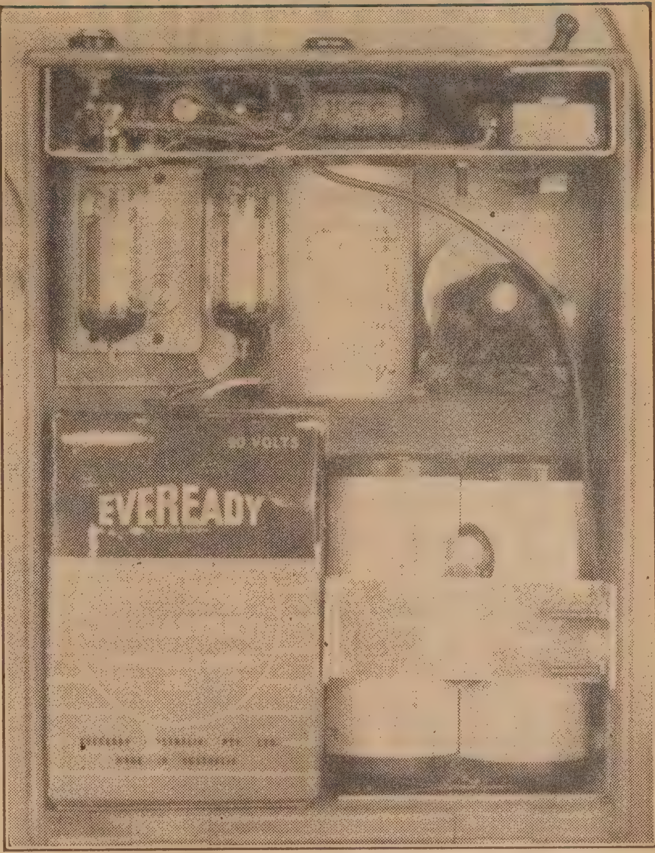
The filament switch is a single-pole single-throw toggle type which is the only one that could be accommodated in the available space. Don't be tempted to clip the unwanted lugs off a double-throw type to make it suitable, since it will ruin the switch in most cases.

The RF choke is a four-section type, mainly because it was easiest to fit under the chassis. Otherwise it is not particularly critical. All the resistors are half-watt types and the capacitors should be midget types.

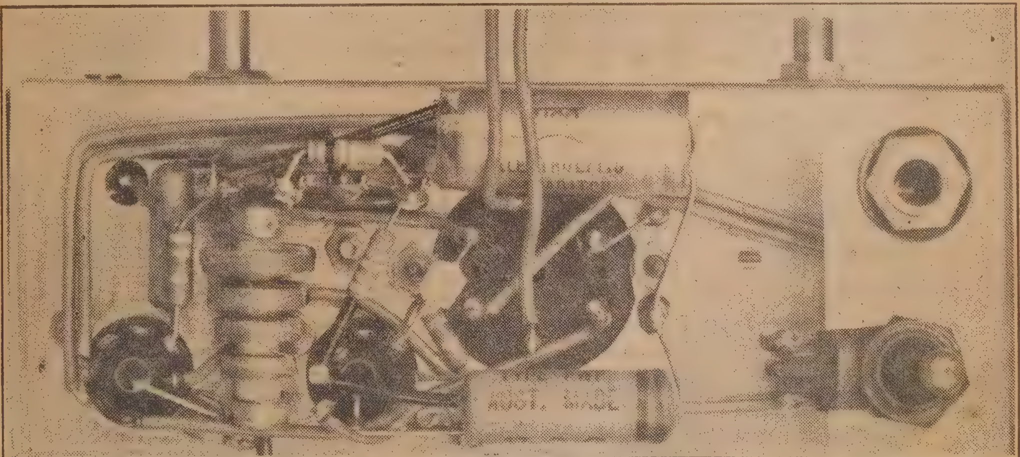
The chassis can be quite easily made from a small sheet of 18-gauge aluminium and all the dimensions are given in the accompanying diagram. Anyone should be able to make their own with the aid of a hacksaw, vice and a few pieces of wood to assist in the bending.

Remember when laying out the job that a small amount of metal must be allowed for each bend, otherwise the job will finish up short. The

HOW COMPONENTS FIT IN CABINET



A rear view of the set in the cabinet. The tuning capacitor is on the left, the reaction capacitor on the right and the coil in the centre. Note the bracket which holds the filament battery and also serves as a negative contact.



A close up of the underside of the chassis. The audio amplifier socket is on the extreme left and the detector nearest the coil The RF choke lies between them and the tag strip is toward the front (top) of the chassis.

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double bend used for the switch and phone jack is the most critical, while the bend at the other end of the chassis should match it if the chassis is to sit square.

The tuning capacitor is normally supplied with mounting brackets, but these are not required. The capacitor is fastened to the front panel by means of two 1-8in x ¼in countersunk brass screws. A hole also needs to be drilled in the panel to accommodate the end of a rod forming part of the construction of the unit.

In mounting the phone jack remember that it must be completely insulated from the chassis. Insulating washers should normally be supplied with it, including a spacing washer to fit in the hole in the chassis. In the absence of a spacing washer a thin strip of insulating tape may be used.

A number of smaller components are mounted or terminated on a four-terminal tag strip near the front of the chassis. Because of the shallow chassis it is necessary to "doctor" the tag strip by straightening the mounting lug, then bending it again in line with the lower edge of the insulating material.

WIRING

For the actual wiring you should follow the circuit diagram or, if this is strange to you, the wiring diagram. Most fellows will probably work a little from each. When it is completed, check it very carefully, because a mistake could damage the valves.

When you feel quite sure that there is no chance of the HT being applied to the filaments, or anything equally silly, you can go ahead and connect the batteries, headphones and aerial and earth. If all is well you should hear signals of some kind immediately, but the set will have to be carefully tuned and adjusted for best results.

The secret of successful operation of all small sets of this type is the proper working and use of the regeneration circuit. It is surprising how few beginners appreciate this and how often the failure of a first set to come up to expectations is due to their failure to get this part working correctly.

Ideally it should be possible to make the detector oscillate with the tuning capacitor set to any frequency. This condition may be recognised by a gentle "plop" or "swish" as the regeneration control is advanced, plus the fact that each station will give forth a whistle as it is tuned in.

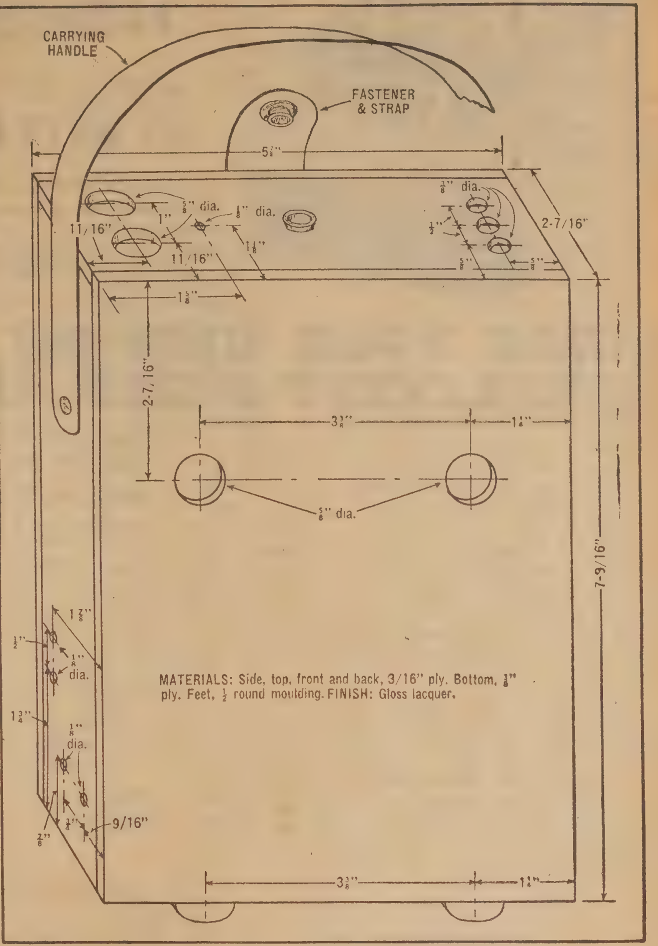
BACK IT OFF

This is not the correct condition for receiving signals, since they will be distorted and the set will also cause interference to neighboring receivers. However, at a point just below oscillation the set is extremely sensitive and selective and this is the condition sought.

To make it easy to achieve this, smooth regeneration control is essential. The control should bring the detector out of oscillation at the same point as it goes in and should go in and out smoothly without undue tendency to "plop".

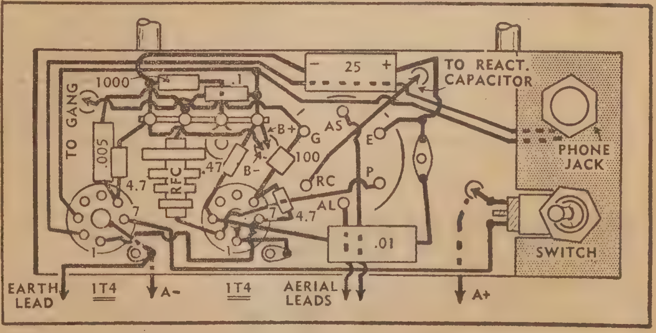
The setting of the regeneration control will vary for different parts of the band and whatever adjustments are made should be checked right over the band. As already explained it is likely that the regeneration may be too violent and the dotted capacitance should be

HOW TO MAKE A PLYWOOD CASE



MATERIALS: Side, top, front and back, 3/16" ply. Bottom, ⅜" ply. Feet, ½ round moulding. FINISH: Gloss lacquer.

These details of the cabinet should enable most amateur carpenters to make their own. It is a good idea to make the chassis first, to allow for minor errors in the metal work.



This wiring diagram should help you to lay out the components and clear up any points which may not be clear from the circuit. Placing of the wires is not particularly critical.

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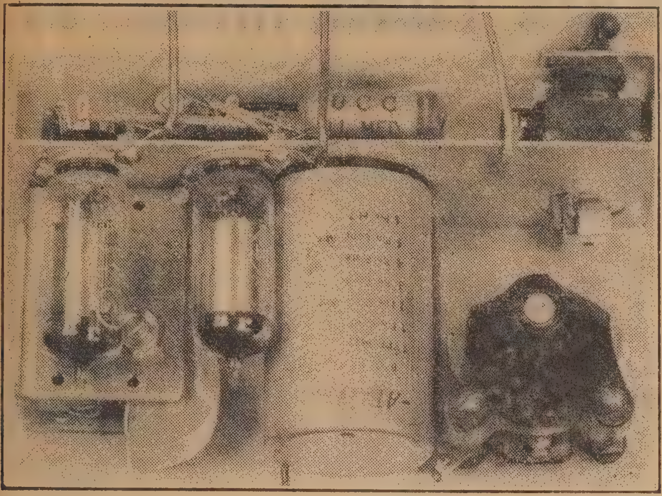
A CLOSE-UP VIEW OF THE CHASSIS



A rear view of the complete chassis. The valve nearest the coil is the detector, the other audio amplifier. Note the end of the phone jack passing through the chassis above the reaction capacitor.

added until correct control is achieved.

Correct adjustment of the aerial length can also be important when working close to one particular station. It is usually possible to select a length of aerial which is long enough to permit reception from other stations, yet not so long as to cause the strong station to swamp everything.

Out in the country, away from the stations, it is not so critical and, within reason, the bigger the aerial the better. However, too large a one may load the set to the point where it will not oscillate. An earth is not always essential, but may help in poor localities. It is most useful in reducing hand capacity effects which may tend to upset the tuning when the controls are released.

The carrying case is made from 3-16in plywood with the exception of the bottom which is 3-8in. All details of this are also included in a diagram. The chassis is supported from the top of the case by means of a single 1-8in x 1in countersunk screw passing through the case and the chassis and being secured with a 1-8in nut. The hole is toward the end of the chassis near the switch and phone jack.

CHASSIS MOUNTING

The chassis is supported upside down, an arrangement which we found necessary to place the knobs in a reasonable position on the front of the case. The switch and phone jack protrude through two holes in the top of the case, while three smaller holes at the opposite end take three tip jack sockets, one for the earth connection and the other two for alternative aerial connections.

Most coils are provided with two aerial connections marked "long aerial" and "short aerial" and these give two degrees of coupling to suit the type of aerial available. The tip jacks are of the type used in test equipment and may have different colored bushes to identify them. They should also be supplied with suitable solder lugs.

The tip jack which is used for the earth connection, and which is directly above the audio amplifier valve socket will need to be cut short to prevent it fouling the latter. There should be ample room for the aerial sockets without modification.

BATTERIES

The batteries are housed in the bottom of the case and there is enough room for either a 67.5 or 90 volt B battery. In either case it will be necessary to provide a packing piece to keep the battery toward the rear of the case, otherwise there is a risk of the contacts shorting to either the coil can or the moving plates of the tuning capacitor when the latter are full open. For the 90 volt size a piece of 3-16in ply will serve, while the 67.5 volt will need 7-8in of packing.

Connection to a 90 volt battery is made by means of a small three-pin plug, while the 67.5 volt type uses press-stud connectors. Both are available from radio dealers.

The cycle lamp battery is held behind the broad "U" shaped bracket bolted to one side of the case. The negative brass leaf presses against this and completes one side of the circuit. To hold the battery in place the free end of the negative lead is bent out at right angles about ¼in from the end. This hooks under the lower edge of the bracket.

A "L" shaped piece of aluminium is mounted against the bottom of the cabinet and against which the positive brass leaf is pressed, thus completing the other half of the circuit. The screws to hold this bracket also pass through the side of the case. In both cases 1-8in countersunk screws are used and the heads recessed slightly below the level of the

(Continued on Page 118)

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HOW TO REPAIR YOUR RADIO SET

Our mantel radio receiver is only twenty-two years old; I bought it cheap from a friend when it had been in use for eight years, and it has since given marvellous service.

UNTIL a fortnight ago, it has required repairs on two occasions. The first was when the man across the road chopped down a tree, which fell across the electric power wires and cut off the electricity supply to the street.

The second occasion was a year ago, when the humming had again become too pronounced to ignore. The manufacturers of the set repaired it for 30/-.

It was therefore most disconcerting to discover, a couple of weeks ago, that the volume control wouldn't work, and all reception came through at full blast.

PENCIL CURE

I phoned the manufacturers, but the serviceman said "Sorry, we can't get that special type of replacement control made at present. However, you might get over your trouble by rubbing pencil lead on the resistor slide".

Now it's many years since the inception of broadcasting, which, coinciding with the days of my youth, constrained me to coil wire on cardboard cylinders and fiddle with cats' whiskers and earphones. But I decided to have a go at it.

I took the chassis out of the cabinet, and after unfastening some friction gears and a lot of screws, managed to work the volume control free and lift off its cover.

I rubbed on a goodly layer of pencil lead, and reassembled the pieces, but with no obvious improvement. In fact it was worse; reception had become intermittent.

A jolt transmitted from the floor would start it off again. Visitors began to regard us as unusually abnormal when they saw us inexplicably hopping about like exponents of some new kind of esoteric dance.

I took the set to the manufacturers. "Only a complete overhaul will guarantee continued reliable functioning of the set, and the cost hardly warrants it," they said. I agreed.

However, I was now on my mettle. I purchased a new standard volume control, and adapted it to the chassis by drilling a hole for the shaft, and of necessity discarding the old gearing. The three wires to the old volume control were unsoldered and fixed temporarily to the new one. It worked! At least the results appeared to be not too bad, so I soldered the wires, when the set promptly went dead.

Not to be outdone, I took two valves into town and had them tested. "They're OK, but very low in efficiency," said the attendant. "What about the other valves?"

"They won't come out, they must be soldered underneath," I replied.

"No, they're not a fixture, probably only a bit stiff," he told me.

So I went back home, and nearly broke my wrist getting the valves out. There were three, set in tiny compartments. They had wires clipped to the top of each, and in taking the clip off one of them, the metal top of the valve came away with it. "Aha!" I thought, "this may be the trouble".

TWO UP-ONE DOWN

The supply house confirmed that the two valves were good, the hatless one a dud.

"Did you test it?" I asked.

"No, it's obviously a dud, just take a look at it," replied the attendant.

"Quite," I agreed. "But please test it, because I want to find out if it was dud before its present dudness. In other words, would it work if it had a hat?"

So they tested it. It was dead.

I bought a new one, but couldn't get a peep out of the set.

"Have I got the volume control wires mixed up?" I wondered. The position of the new control was opposite to the old one, and I doubted whether I had reversed the wires to suit. So I unsoldered them, and tried every possible permutation and combination, albeit with fruitless results.

Then the GREAT IDEA struck me! There was a thing like a short black cigarette marked with mystic hieroglyphs ".01 Mfd 1000 V.T." and I didn't like the look of it. So I short-circuited it to the volume control and after a few more tries with the three wires, "Hey presto!", a terrific blast of crystal-clear music came through from 2FC.

A SHORT CUT

So I removed the defaulting ".01 Mfd &c." and soldered the connections. Since then, we've had beautiful reception. Admittedly there are a few difficulties.

The volume control doesn't alter the volume very much, and we have to turn it in opposite directions for different stations to produce any one effect. We never have to increase it because it is always too loud. To some extent this can be overcome by tuning just off the station; but this has its hazards. Without the greatest of care a lot of hen-clucking noises are produced.

Tuning-in is great fun, and reminds me of the "good old days" of "wireless." As the pointer approaches a station, what we used to call "heterodyning" (is it still called that?) is objectionably evident. Then there is much hissing, plopping, and a sort of Morse code. However, I am somewhat doubtful whether this is really telegraphy reception; it sounds more like the good old set just doing its best in spite of my bush doctoring! But with the dial pointer dead on a station, reception is better than it ever was, but oh!, how to tone it down?

I'm going into town to buy a new ".01 Mfd 1000 V.T." (and I might even buy a technical book on radio).
— V. Hardy.

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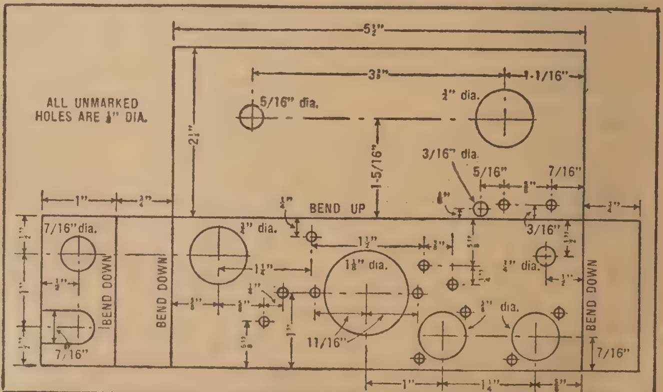

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A COURSE IN TELEVISION

(Continued from Page 51)

pictures per second, which is slightly higher than cinema practice.

The figure does, however, correspond with the mains frequency and is intended to minimise any interference patterns which might appear on the viewing screen due to hum pickup in the electronic circuits.

NON-SYNCHRONOUS

Early television systems often had the picture repetition rate synchronised with the power mains but this practice is deliberately avoided in modern equipment. While the picture rate remains nominally at 50 cycles per second, it is controlled by very precise timing circuits at the transmitting end and communicated to receivers by special synchronising pulses.

We shall be studying this matter in detail later on.

Because the power mains in America supply current at 60 cycles, they have adopted this same nominal figure for their TV picture repetition rate. It gives them a useful margin in terms of flicker but is not without its disadvantages.

In particular, it complicates the televising of standard motion picture films, which form a fairly large proportion of the program material.

FILM SCANNING

The subject of film scanning will probably be discussed much later in the series as a matter of interest. It is sufficient to record just here that, when televising films over a 50-frame system television, current practice is to run the film slightly faster than normal. By stepping it up to 25 frames per second and deriving two scans from each frame, the required 50 scans per second is obtained.

In the discussion thus far it has been assumed that simple sequential scanning is used, as illustrated in figures 4 and 5 last month. In actual fact, all modern television uses a system called "interlaced" scanning, which yields a considerable economy in circuit requirements for a small loss in picture definition.

HIGH LINE RATE

With a simple scanning system, operating at 625 lines and 50 frames, a total of 31,250 lines would have to be scanned per second (50 times 625). Though not an impossible figure for an electronic system, it is one which could well be reduced in the interests of simplicity.

The interlaced scan idea allows it to be cut in half. Figure 13 indicates how it is done.

When line 1 has been scanned, the light or beam flicks back to a position whence it proceeds immediately to scan line 3. All the odd lines are scanned in sequence until the bottom edge of the image is reached.

The light or beam then moves back to the top of the image and begins to scan line 2, followed by lines 4, 6, 8 and so on.

Thus all the odd lines are analysed during one scanning sequence and reassembled in the same order on the viewing screen. During the following scan sequence, the even lines are filled in.

As far as the viewer is concerned, the outlines of the picture are filled in at the required rate of 50 frames per second, so that no flicker problem results. However, each scan contains only half the total number of lines—either the odd ones or the even—and the total number of lines scanned per second is reduced to 15,625 (Australian system).

As we shall see a little later, this effects a very marked economy in the operation of a television system yet yields a result which is far better than could be expected using simple scanning and only half the original number of lines.

The one vital requirement is that proper interlace be preserved so that the odd and even lines together fill the whole surface of the screen. If the lines tend to overlap, on the other hand, the space between them is left blank and a very coarse looking picture results.

Just in passing, it is worth noting that some confusion exists in relation to the terminology of interlaced scanning.

In Britain, the total number of scans, whether odd or even, is known as the "frame rate", being 50 per second. In the US the frame rate is taken to mean the rate of presentation of complete pictures actually 30 per second. The picture repetition rate is known as the "field frequency", being 60 per second.

Next month we can go on to discuss the basic principle of the cathode-ray tube and trace its development from the early crude prototypes to modern picture tubes and camera tubes. We shall see how an electron beam, suitably deflected, has completely displaced all the earlier mechanical principles.

Something of the effect is illustrated in figure 15.

(To Be Continued)

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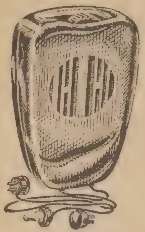

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YOU WANT TO BUILD AN ORGAN?

In this concluding instalment, the author sums up the requirements of a home-constructed electric organ and the obstacles which have to be overcome. He shows that, while a good organ cannot be built cheaply, it need cost only a fraction of its value on the commercial market.

PART THREE

by R. A. B. Tarrant

From the foregoing, and that was its purpose, it can be seen that there is a great variety of means to a given end — the given end of building an organ that is to be a pleasure.

At the very outset of this article, it was stated that the would-be constructor faced three requirements — money, knowledge and time.

Firstly, let us look at money, for, by now, the reader will have realised just what he is up against regarding knowledge.

ORGAN KEYBOARD

Having decided on a circuit, the constructor is advised to find himself a keyboard — piano-type will do, although it is very nice to have a true organ-style set of keys, that is, with overhanging fronts. If he wants an organ with two sets of keys, then two similar keyboards will be required.

Each keyboard should be of five octaves, starting from the note C and finishing on C. Keys from an old "pedal" organ — harmonium or American organ — will do, but it will be found that these are nearly always of the scale F to F, and a fair amount of juggling around is called for to bring them to the RCO standard of C to C.

It should be noted that it is almost impossible to obtain new organ keys under about £30 per manual — yes, that's right! Pedal keys, too, are expensive, costing about £30-35 for the standard range of 30 or 32 notes. Add to this the cost of building up a console — usually a wooden frame with plywood and veneer finish—in which to set the keyboards and mount the amplifiers, generators and power supplies, and we find that we have reached the £100 mark.

The writer wishes to stress, here and now, that probably the most vital part of an electronic organ is the switching associated with stop tablets, manual and pedal keys. Depending on the number of circuits being dealt with, each key, on depression, may have to make or break anything from one to 10 different sets of contacts, although anything over four is not usually met with.

COST OF SWITCHES

These switches must be robust, clean in action, silent and completely reliable—such a switch, obtained commercially, costs in the vicinity of 9/-. With an organ of 60 notes an expenditure of £27-£28 on such switches is called for: with a full compass organ of two manuals and full pedal board the cost reaches the £75 mark.

The commercial switches referred to are of the telephone-leaf type, although it is possible in many organs to use the standard electric action pipe organ style, in which a "wiper" shorts two, three or four fingers to each other.

Many manufacturers, in fact, find that 50 pc of their costs lie in the non-electric portion of the organ, which, too, is what a well-known Australian firm has also encountered in their production.

It can well be that the home builder will find the same outlay ratios apply to his costs.

Strangely enough, the building of the tone generators is not really a difficult job—just time-consuming—and the really hard part is the development of the console and key-switching arrangements.

As for the generators, the home constructor is advised to follow commercial practices and go in for as many separate chassis as possible—several makers using one chassis per note. With frequency dividing systems, however, and it is this which will appeal most to the amateur, one chassis per sign will be adequate—even necessary. That is, as previously mentioned, all C's will come off the one chassis, all C sharp off an adjoining one, and so on, thus giving us 12 generator chassis per organ.

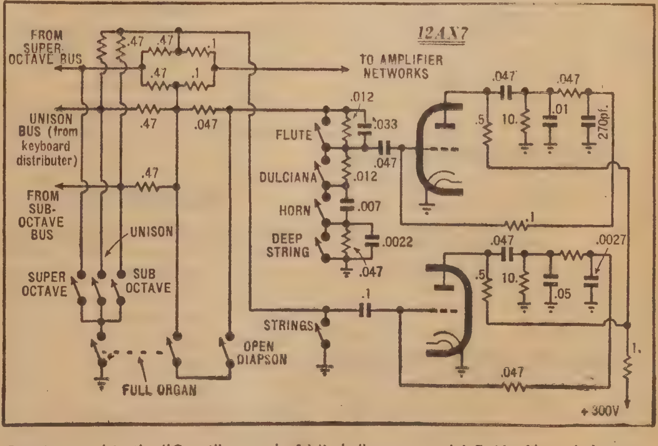
Invariably, twin triodes are used for frequency division—in the case of the Baldwin and Minshall organs, two notes, one octave apart, coming from each triode. Taking, as an example, such a frequency dividing network we find that to give us our full five octaves we need a minimum of 36 double triodes, and the most usual types—6SN7, 6SL7, and 12AX7—cost 26/3 each, retail. That means, your basic requirements of tubes for the simplest of organs will cost a possible £47.

OTHER STAGES

Then, too, pre-amplification stages and a possible outphaser stage (see "Electronic Musical Instrument Manual" 2nd Edition p 148 and 154 and "Electronic Organs" p 52) require three, four or five more tubes.

So far, we have only generated our sawtooth waves, preparatory to forming from them our requisite organesque and instrumental "voices".

What are we up against by way of cost in the tone forming circuits? If Dr. Kock's system of tone synthesis, as used in the Baldwin Organ, is adopted, we shall need eight formant chokes costing 25/- each, six dozen resistors and four dozen condensers, making a total of £15-£16. On the other hand, if we use the purely electronic system devised for



Circuitry used in the "Great" manual of Minshall organ model E. No filter chokes are used in the audio lines, formant effects being achieved by phasing in feedback circuits. Numerous resistors are used to isolate formant circuits one from the other.

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the Minshall Organ, we will require about £8 for this part of the instrument. Such pricing does not include the stop switches.

Don't forget, too, that the generator and tone forming metal chassis are going to run into money—probably £10 in all, including valve sockets.

Another item of expense will be shielded cable, for valve generator electronic organs are very liable to hum troubles, and a considerable amount of care is required to prevent the least trace of this objectionable consideration. Usually, the outputs of the generators are brought from the tone generating chassis, by such shielded cable, to a distribution strip which, in turn, must be well screened—even to the extent of having a lid on the box containing the strip. From the distribution strip leads are taken to the tone-forming chassis.

THE CONSOLE

Now we come to a really expensive item.

We have spent, by now, at least £150 on a good looking console, and a generator system capable of giving us a potentially satisfactory musical instrument. To do justice to this outlay we must provide a suitable amplifier.

Even for the home a 20 watt, good quality amplifier, with a good speaker system, is essential.

The reason for the 20 watts is that the bass notes must be allowed for, a "thin" base being intolerable. Strangely (although the writer may be taken to task in "let's buy an argument" for saying it) a hi-fi treble is not necessary. A speaker system giving reproduction to 8000 cps will be found to be very satisfactory—the bass end is the one that has to be catered for, especially.

Too many articles have appeared in "R. T. and H" over the years on different types of amplifying equipment to need an exposition on the subject. Suffice it to say that a suitable amplifier with a properly baffled speaker is going to cost, at the least, £60.

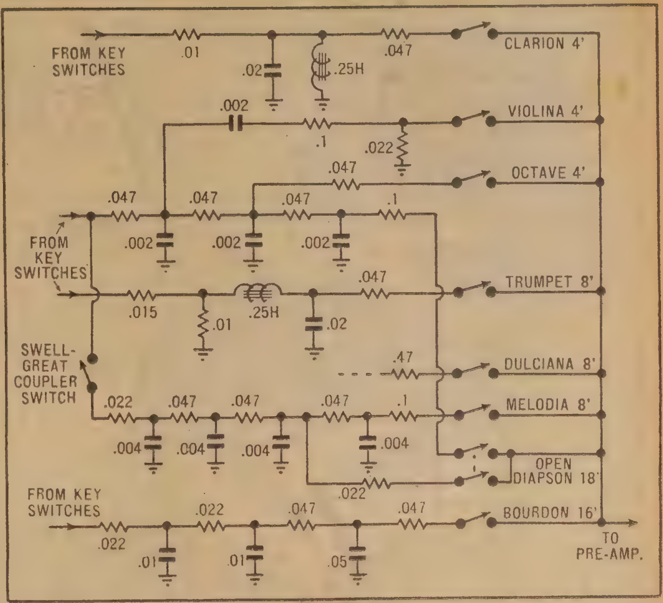
Then, too, there is the matter of power supplies. The Australian firm previously mentioned uses, in all, 47 tubes in their instrument and the filament drain, alone, is of no small consideration, calling for a separate filament transformer. The plate voltages of the oscillators have to be stabilised and, while the current drain is, fortunately, most moderate, we find ourselves in need of voltage regulator tubes, and a particularly well filtered power supply.

Another point is the matter of controlling the volume of the instrument. This is usually done with a foot-operated swell pedal giving a wide range—from a whisper to full output. The obvious thing is to utilise an ordinary potentiometer driven by a belt and pulley system from the pedal, but, unfortunately this arrangement is not a success.

VOLUME CONTROL

It will be found that the "pot" won't stand up to much of this sort of treatment, wear on the resistive element soon showing up, since use of the swell pedal is being continually called for. Another ground is that this is usually a high impedance circuit, and is therefore liable to hum, which cuts out the use of a wire-wound unit, too.

BALDWIN—TONE COLOR FILTERS



Tone color filters used for the "Great" manual of the Baldwin organ. Some of the resistors serve to isolate individual filters, others not shown equalise level. Filter values given are standards for the organ voices shown and may be adopted by home builders.

The only alternatives are a low resistance wire-wound potentiometer in a cathode follower circuit, or a moving contact system, in which movement of the swell pedal moves an arm from contact stud to contact stud, such studs being linked by carbon resistances.

The Robb Wave Organ used an electronic swell pedal in which the mutual inductance of two coils was varied by moving an iron core in and out of the centre of their winding, thus providing a completely silent "volume control", and one not subject to wear. Here, indeed is a rich field for the experimenter's plough, with as many solutions as there are days in the year.

TYPICAL INSTRUMENTS

Before assessing the total financial outlay for a reasonably satisfactory home built organ, it is only fair to look at a typical type of commercial instrument which does not resort to frequency division. Such an organ will, of necessity, be a more expensive proposition, firstly, because at least one tube per two notes is called for and, secondly, because it is almost certain that inductances will be required in quantity.

Such a commercial instrument is the Counsavata, built by the American firm C. G Conn, Ltd. Also, a basically similar and very successful product is made in Great Britain by the Miller Organ Co. Ltd., under the name of the Constant Martin Organ (incidentally, Mr. Constant Martin, a Frenchman, is the inventor of the Clavioline, previously mentioned in these columns).

The smallest of the Conn organs is the Connsonette, having one manual of five octaves and two octaves of pedals, and it is estimated that, to duplicate this instrument, an outlay of about £300 would be called for, the expenses being the manual and pedal keys and console, the cost of some 50 tubes and a good quality amplifier, no small part of the expense being associated with the requisite inductors.

The reader will understand that in the case of frequency division, all octaves are in complete time, and, therefore, approximate the theoretically correct frequencies very closely, indeed. As a point of interest, it is not possible to deviate more than 0.25 per cent from true pitch without sounding "off": the average frequency divider/generator system would not vary more than 1/1000 part of this, as far as octave relationship is concerned.

VAGARIES OF TUNING

However, we can be too exact! The very weaknesses and failings of the best tuners' ears, lend to the instrument being tuned a certain character and charm. So it is with electronic organs in which each note must be individually tuned — whilst tuning may present difficulties the finished job is, undeniably, a more "human" instrument than the (mathematically) perfectly tuned one.

The Connsonata Organs need one triode per note of the organ, double triodes 12AH7 being used. Except for

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As he spoke he folded the 4x5 the model 2c, which has one big chassis per manual, the Connsonata uses one chassis per four notes, that is, there are two valves and four tuning inductances per chassis. The tubes used are not miniatures — although they could well be—and, as a consequence, the chassis take up a considerable amount of space. In the model of the Connsonata, seen by the writer, there was not room to put a thimble in the shelves at the back of the console!

One home builder, we know of in Sydney, has built what appears to be quite a pleasing model of the Connsonnette—a single manual and pedals version of the larger instrument—and, judging by his account of the design and construction of the generator transformers, the task is quite a formidable one. In his instrument there would be hundreds of windings, which would constitute not only a considerable expense but a prodigious amount of work. To have the windings done by a commercial firm would cost over £100, at the very least.

HARD TO COPY

The same remarks apply to other organs of this type—notably Allen, Constant Martin and Thomas. These three are more difficult to copy, however, particularly the Allen and Thomas instruments which, in conjunction with being expensive, are, in the writer's opinion, far and away the best of all the electronic organs he has seen and heard. With this superior quality comes complication of circuitry which would be well beyond the capabilities of the home builder.

So there we have it. To sum up, I would say, "Build a valve type of generator utilising frequency division: don't spend too much money or time playing around with reeds and other devices. Lots of very experienced engineers with plenty of capital behind them have already explored this field to the full."

Regarding circuits of these instruments, the only source of information —short of writing to the manufacturers (most of whom will not be responsive) — is the popular radio periodicals and text-books. Even the patents themselves do not, strangely, reveal full details of circuitry, and give only general principles.

As stated at the outset of this article, the would-be builder is strongly advised to experiment with a monophonic instrument, first. Quite satisfactory and pleasing "one-finger organs", capable of imitating the violin, saxophone, clarinet, oboe, trombone and a host of other solo instruments, can be easily and cheaply made—for about £15 plus the cost of a keyboard. The experiences gained from such construction would be of great benefit when the time came to start on the big job—for big it is. The writer estimates that, to duplicate the Minchall Organ, it would take 600 hours' work—not including the construction of the console.

PLACE TO START

Even a melodic instrument, such as mentioned above, and which uses only three or four valves, takes about 40 hours to construct. Such simple electronic musical instruments, incidentally, demonstrate the abilities of tone forming circuits very well and, if the builder of an organ is of an experimental nature, and wants to put his ideas into practice, then he can do no better than use a thyratron sawtooth generator covering, say, five octaves, and hitching his projected mixing, formant and filter units to this.

A good book on the subject, advertised in these columns, is "Simple electronic musical instruments for the constructor" by the well-known writer Alan Douglas, who gives a variety of circuits and suggestions for elaboration. Incidentally, the chapter on a thyratron generator is an admirable source of information for the man who wants to build up a complete gas-tube organ.

PEDAL MANUAL

Regarding the pedal notes, it should be pointed out that an elaborate pedal generator system is **not** a normal requisite. Only for concert organs and the more expensive pipe organs is a pedal required to have a number of voices at different pitches. In fact, in two of the most successful commercial electronic organs the pedal notes are catered for by one tone, only, variations in volume being the sole change available.

Particularly in the home, all that is required of the pedal clavier is that it provide a foundation for the organ as a whole. The constuctor is cautioned about having too many good intentions for the pedal department: make-up as simple a one as possible and, if you feel like it, elaborate later on.

Naturally, you will want to get your generators made and going as a first step but here, again, the writer suggests that the most difficult part be tackled first. This is the construction of the console, the mounting of the keyboards and the placing of the switches under the keys.

Considerable time, patience, care and expense will be called for here, but a thorough job will ENSURE a good organ, and the rest of the instrument may be built-up with impunity, knowing that the hardest part is done—and has been done well.

If you are of an experimental turn of mind, it may pay you to put in four or five contact leaf switches at the outset—be they ever so expensive—and these will do for any type of organ (except one employing additive synthesis) that you are ever likely to contemplate.

ESTIMATE OF COST

In conclusion, assuming that you have the tools—drills, meter, soldering iron, metal working and woodworking—we can estimate the minimum cost of a home-built, single manual organ with 30 pedal notes as follows:

Console, including new pedal and new manual keys and leaf switches	£100
Amplifier	60
Tone generators and filter circuits, including power supply	80
	£240

That figure is the absolute minimum, and does not allow for the type of generators used in the Baldwin Organ: the transformers, alone, in that instrument would cost £120 extra.

However, for all the work and care that went into such an organ, you would have something to be proud of, something more versatile and interesting than a piano (and cheaper) and a lovely musical instrument that you would be proud to show to anyone.

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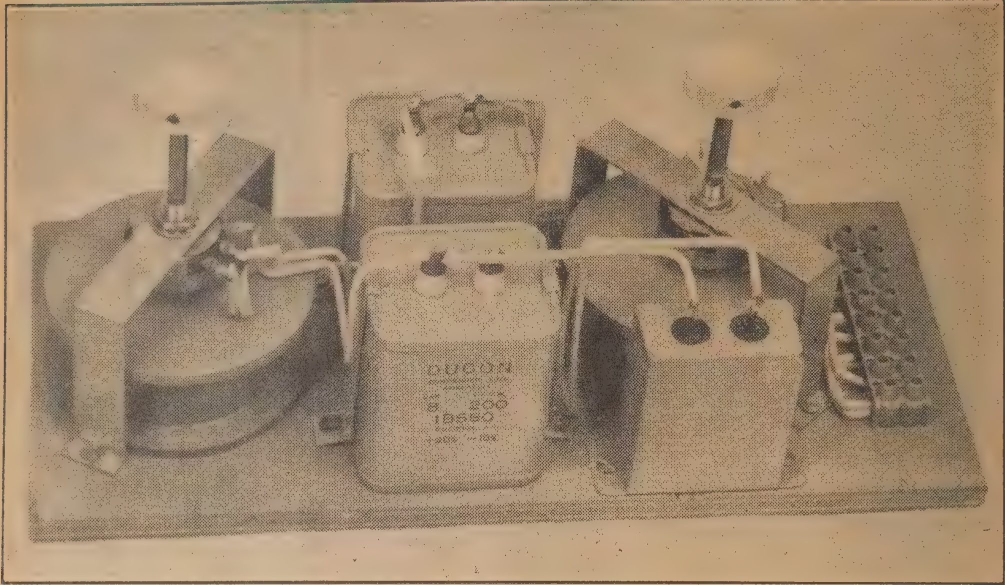


A photograph of the completed unit with the cover removed to show the layout of the various components. The output controls for the middle and top speakers are mounted above the divider network coils.

MULTIPLE SPEAKER NETWORKS

Elsewhere in the issue, the Editor has discussed the advantages of using multiple loudspeakers with appropriate divider networks. This article examines the design of such networks and gives details of their actual construction.

by Reg. Rawlings

THE article is not designed to investigate all the possible forms of divider networks but rather to simplify the subject and to guide the reader to those circuits which are accepted as good practice, and which can be duplicated with limited facilities.

Figure 1 illustrates the basic principle of a divider network, in separating the frequencies handled by two speakers. If we assume that the cross-over frequency is 1000 cycles, then, in the ideal case, the high frequency speaker would handle only those frequencies above 1000 cycles and the low frequency speaker would only handle those frequencies below 1000 cycles.

CUT-OFF FREQUENCY

In practice, this is not possible and the complexity of the divider network becomes greater, the closer we aim at a sharp cut-off frequency characteristic. As in many radio applications, other things have to be considered, and the final arrangement adopted is a compromise between various conflicting factors.

The rate of cut-off is usually quoted in terms of "decibels per octave", as shown in figure 1. It can be seen that the 6db curves have dropped from zero reference to -6 db at a frequency of 500 cycles and again at 2000 cycles. These frequencies are respectively one octave below and one octave above the cross over frequency.

Lines depicting slopes of 12 and 18db per octave have been added for the sake of comparison.

A divider network is normally placed between the transformer secondary and the speakers. This allows a network to be added to an amplifier system without any changes to the amplifier. Because of the low voltage at the secondary of the transformer, the coils in the network do not have to be wound with high insulation properties, which is a distinct advantage to the home constructor.

However, the audio current in the secondary of the amplifier transformer is large and, to minimise network losses, the coils must be wound with heavy wire. Typical gauges are from 12 to 20 SWG and the wire can either be plain enamel or cotton-covered.

Cotton-covered wires give a superior finish when the coil is to be impregnated with varnish or other material. The cotton soaks up th evarnish and, when the varnish is dry, it becomes one solid and robust unit.

INSULATION

From the insulation point of view there is probably little to choose between the two types of wire, although greater care is necessary with the plain enamel to prevent chipping or scraping the enamel during winding. As the cost of the cot-

DESIGN DATA FOR NETWORKS

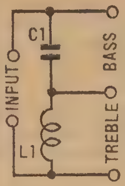
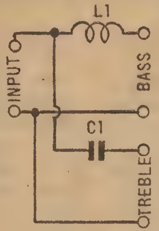
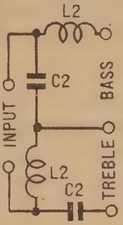
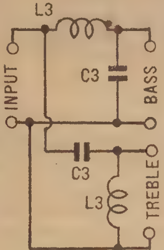
TYPE	SERIES	PARALLEL	GENERAL VALUES	VALUES FOR 15Ω SPEAKERS
¼ SECTION 6db PER OCTAVE			$L1 = \frac{Ro}{2\pi fc}$ $C1 = \frac{1}{2\pi fc Ro}$	L1 = 2.5mH C1 = 12uF CROSSOVER FREQ. 1000 c/s
½ SECTION 12db PER OCTAVE			$L2 = \frac{Ro}{2\sqrt{2}\pi fc}$ $C2 = \frac{\sqrt{2}}{2\pi fc Ro}$ $L3 = \frac{\sqrt{2} Ro}{2\pi fc}$ $C3 = \frac{1}{2\sqrt{2}\pi fc Ro}$	L2 = 2mH C2 = 16uF L3 = 4mH C3 = 8uF CROSSOVER FREQ. 800 c/s
WHERE L IS IN HENRYS — Ro IS SPEAKER IMP.— F IS IN FARADS — fc IS CROSSOVER FREQ.				

Fig. 2, showing four of the most used constant resistance divider networks together with the appropriate formulae for calculating the network constants.

ton covered-wire is greater, it is doubtful if there is any advantage in the home constructor using it, providing due care is taken with the actual winding of the coils.

The introduction of a divider network into a speaker system does result in some power loss and it is to keep this loss to a minimum that the coils are made of heavy wire. The loss incurred is usually about 1 decibel in a well-designed network.

To prevent introducing distortion, the divider coils are normally air-cored, although it is possible that dust type cores could be used. As the values of inductance that are required are quite low, it is not difficult to make satisfactory air-cored coils.

SPEAKER LEADS

The insertion of a divider network does not place any restrictions on the use of speakers at a distance from the amplifier, over and above those without the network. The same rules apply, namely, that the wires connecting the speaker to the output transformer should not be so light or so long as to introduce appreciable dc resistance compared with the voice coil impedance.

At this point some mention should be made of the type of capacitors to be used in the networks. The main requirement is that they be stable in value and have low loss at any frequency in the audio spectrum. This calls for paper or oil-filled paper condensers.

The use of electrolytics is not satisfactory as they require a polarising voltage, and they are not stable in their capacitance value.

The initial capacitance value should be as close to the required value as possible, and the generally acccepted tolerance is 10 pc. A variation in capacitance will modify the designed cross-over frequency, but this is not critical within reasonable limits.

Because the output of an amplifier is already matched to the impedance of the speakers, the impedance of the divider network to which the speakers are connected to it is of considerable importance.

Frequency divider networks can be classified into two groups:—

(1) The constant resistance type which derives its name from the fact that, when it is terminated by a constant resistance, it presents at its input terminals a constant resistance at all frequencies.

(2) The filter type, which is a true filter, being designed to operate with a source and a load equal to its own characteristic impedance. Under these ideal conditions it will give zero loss in the pass band and steep attenuation in the stop band.

TERMINATION

The precise input impedance of both types of networks can only be stated on the assumption that the terminating impedances are purely resistive. The theory of the networks falls down in their application to speaker divider systems for, while speaker manufacturers state a value of impedance for their speakers, this is only the value at a nominal frequency. The value will vary widely over the frequency range, due to mechanical resonances and to air loading of the speaker, together with the inductive effects of the voice coil. These variable loadings modify the anticipated performance of the network and the results are always somewhat poorer than anticipated.

Apart from the actual frequency characteristic of the networks the second most important electrical characteristic is the nature of the load reflected back to the output valves.

In the case of the constant re-

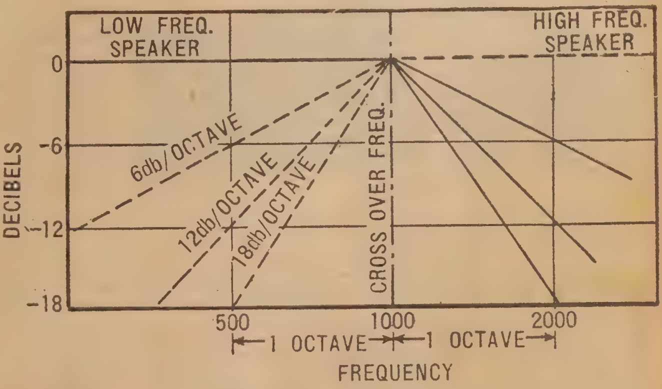


Fig. 1, Illustrating the principle of a speaker divider network and the various rates of cut off above and below the cross-over frequency.

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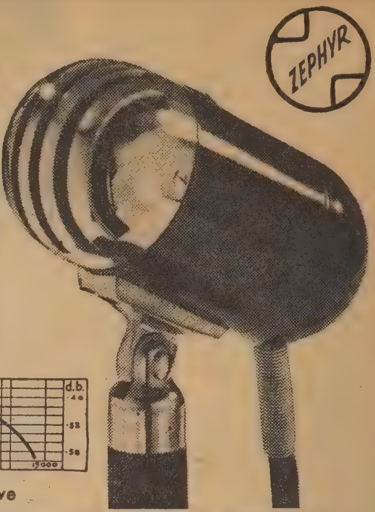

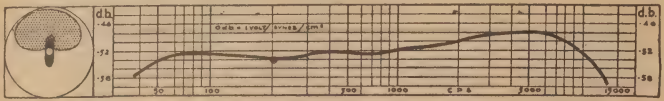

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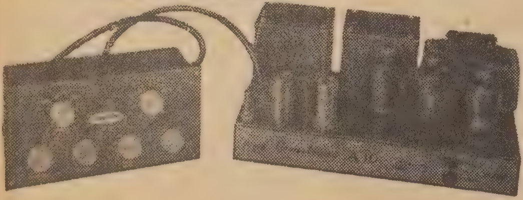

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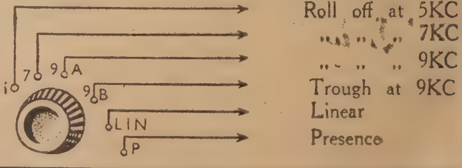

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sistance network this is more nearly a resistive quantity but in the case of the filter network it has resistive and reactive components of its own, which are additional to any characteristics of the load.

In some amplifiers with larger degrees of negative feedback, taken from the secondary of the output transformer, this variable reactive load can aggravate any tendency to amplifier instability.

A further advantage of the constant resistance network is that the values of the inductors and capacitors are the same in each section of the network in the case of the two most used types.

All things considered, constant resistance networks are generally preferred and, in this article, we will deal only with this type of divider network.

PARALLEL OR SERIES

Before proceeding with the discussion reference should be made to Figure 2 which shows the four constant resistance types in most common use. There are basically three circuits which can, with suitable variation in the circuit values, be designed to feed speakers in parallel or in series.

The choice of a series or parallel connection for speakers is a matter of economy in the divider network.

This can be seen by comparing the values given for the half-section series and parallel types. In the parallel type, although the inductors are twice the value, the capacitors are halved. As the saving in cost of the capacitors is generally greater than the increased cost of the inductors, the parallel type is the least expensive to construct.

It now remains to choose either the quarter, half or full section.

Because of the complexity and cost of the full section, this type of network is not normally used. It also has the further disadvantage of giving greater transient distortion at frequencies in the cross-over region

Both the quarter and half section types are in general use and, although the steeper cut-off characteristic of the half-section is to be preferred, very little difference is noticeable in using either type.

Much depends upon the speakers being used and their ability to handle power outside of the frequency range they would normally receive from the divider network.

Particular care is necessary when the high frequency speaker has a critical low frequency cut-off, as frequencies below this can cause distortion and possible damage to the unit. Perhaps the most logical step is to adhere to the speaker manufacturer's recommendations in this respect.

BALANCE CONTROL

An additional control, added to some divider networks, is a potentiometer on one or more of the divider network outputs to balance the acoustic level from the individual speakers. It often occurs that the high frequency speaker is much more efficient than the low frequency speaker and, to obtain satisfactory balance, its output must be reduced.

Some manufacturers do not recommend this additional control and, presumably, their speakers are matched fairly closely in efficiency over the range in which they operate.

A THREE-SPEAKER NETWORK

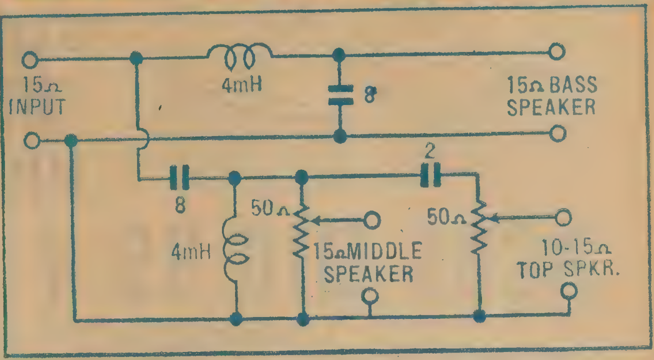


Fig. 3. The circuit recommended by Wharfedale for use with their speakers. This circuit has individual output controls for both middle and top speakers to allow correct tonal balance to be achieved.

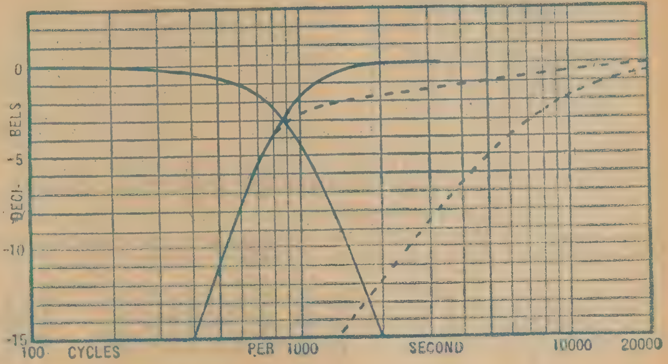


Fig. 4. These curves were taken on the completed network shown above. The dotted curves show the output to the high frequency speaker and the modification that it introduces to the middle speaker output.

Mention has been made by the Editor of three speaker networks and this may appear, at first sight, to complicate considerably the type of divider network required. This is not the case, as the high frequency tweeters are normally fed from the normal divider network through an additional series capacitor.

The reactance of this capacitor decreases with rising frequency and permits only the high frequencies to be passed to the tweeter. The region over which this occurs is determined by the value of the condenser, and a common value is .5 to 2mfd.

TABLE OF TURNS

(19 SWG enam., or 18 B&S enam., on the former shown in Fig. 6 for various inductance values).

mH	Turns	mH	Turns
2	244	4	320
2.5	264	4.5	337
3	284	5	354
3.5	302	5.5	369
		6	384

While some manufacturers refer to this as a divider network with two cross-over frequencies, this is not strictly correct. At the higher frequency end of the spectrum there is no change in the transmission characteristics of the network feeding the two lower speakers but only the addition of a tweeter speaker to the output of the higher frequency section.

CROSS-OVER FREQUENCY

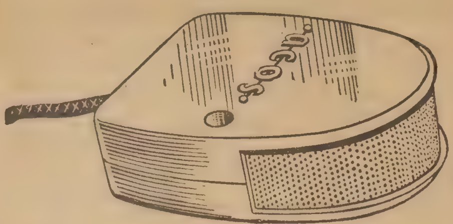
It thus resolves into a normal two-speaker divider network with the addition of a tweeter speaker fed from the output to the middle frequency speaker.

Before selecting cross-over frequency for the network it is necessary to consider the possible combinations of speakers that will be used together. A total of three distinct combinations can be anticipated and these are as follows:

(1) A speaker to handle the bass only and another to handle the middle and high frequencies.

(2) A speaker to handle the bass, another to handle the middle register and a third to handle the high frequencies.

(3) One speaker to handle the bass and middle and a second to



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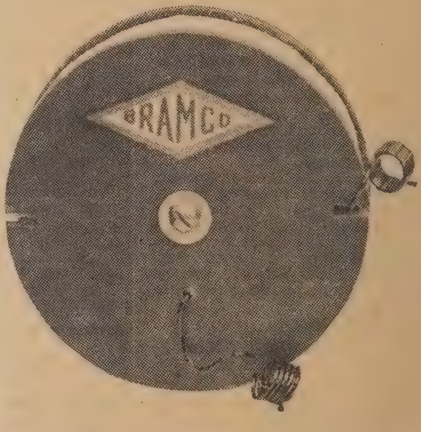

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handle the high frequencies only.

Taking these in turn the requirements of the cross-over frequency may be summarised as under:

(1) The crossover should be made low to avoid intermodulation of the higher frequencies by the bass speaker and a suitable value is 500 to 1000 cycles. This can normally be done without any danger of overload to the middle and high frequency speaker as this will normally be of the cone type.

(2) Much the same conditions apply here as in (1) since the middle speaker will normally be of the cone type and the high frequency speaker will not receive any of the middle frequency power because of its series capacitor. This capacitor is normally chosen to bring this speaker into circuit at or above 5000 cps.

(3) This combination of speakers does not normally call for a divider network, the high frequency speaker being simply fed through a series capacitor. The value of this capacitor is chosen to bring it in to operation at between 5000 to 10,000 cps.

CONSTRUCTION

We now come to the actual construction of the divider network coils. As will be seen from the circuits recommended by the various manufacturers more than one value of inductor may be required. To avoid the need for more than one former size we have standardised on a former which will allow sufficient space for any of the coils to be wound.

The cross section of this former is shown in Figure 3 and the main dimensions should be maintained as closely as possible.

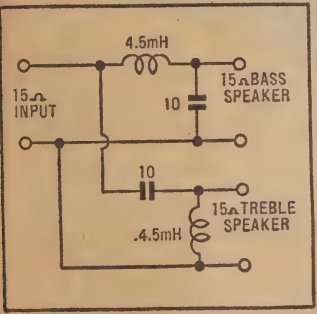

Fig. 5. The half-section filter recommended by Goodmans for use with their speakers.

The cheeks were made from 3/16in three-ply. A material of at least this thickness is needed, as the thrust on the cheeks is considerable when the heavy wire is wound on to the thicker former. Possibly some of the thicker hardboards could be used if they are already on hand, although some of these boards will not glue very well to the centre former.

We made these cheeks by first roughly cutting them out with a saw and then trimming to the line with a course file.

A ¼in hole was then drilled in the centre, the two cheeks put together and a screw passed through them. The free end of the screw was then put in the chuck of a portable drill fixed in the vice. The drill was switched on and a file used to roughly trim the cheeks to size.

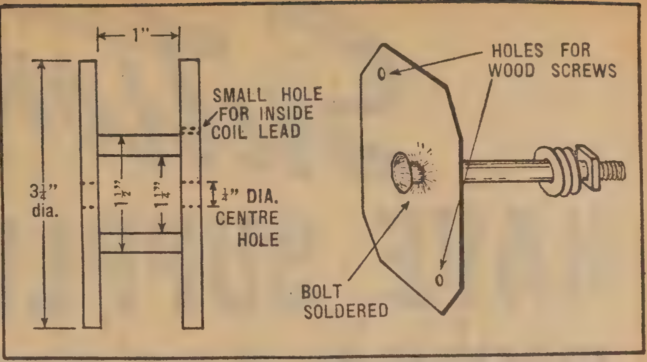

Fig. 6. Details of the former used for the divider network coils and the driving spindle for the actual winding.

The final finish was obtained by using a coarse sand paper while the cheeks were rotating in the drill.

The centre core of the former can be any non-metallic material, and it would probably be possible to obtain a piece of circular timber from the local timber supplier. Failing this, the centre core could be made up of a number of discs cut from plywood and trimmed in much the same manner as above.

We used some heavy bakelised paper tube, which we had available. The size of this tube was 1½in outside diameter and 1¼in inside diameter. This gives a wall thickness of 1-8in, which is sufficiently strong to prevent it collapsing when the wire is wound on to it. The thick wall also gives sufficient area for the glue to adhere to, when the former is stuck to the end cheeks.

It is important that the centre core be made so that the finished distance between the insides of the two cheeks is exactly 1in. This is because a 1in wide tape will be used in the actual winding of the coil and this tape must exactly fit the distance between the cheeks.

PARALLEL CHEEKS

For the same reason the coil cheeks must be accurately parallel and this can be assured by making the two faces of the centre core parallel. This is not unduly difficult with the size of centre core used for this former.

The type of glue chosen was the cold-water powdered casein glue available from local hardware stores. This is easy to use and, provided that the former is held tightly together with a screw after glueing, a satisfactory joint will result. It should be left to dry for some hours, preferably overnight, before attempting to wind the wire on to the former.

Apart from the former and the wire the only other material required for the coils is a quantity of 1in wide adhesive tape. This should preferably be of the type having a smooth outer surface, as it will allow the wires to be pushed along.

The approximate number of turns of wire required for a given inductance is given in the table. If means are available to adjust the inductors to exact value the number of turns wound on should be increased by 10 pc. This will allow turns to be removed to obtain the exact value required.

If means of measurement are not available the number of turns shown by the graph should be used. Provided a good job is made of the winding the final value will be very close to that required.

Before actually starting the winding a number of pieces of tape should be cut off so that they are ready for immediate use. The reel of wire should be mounted on to a spindle so that it can revolve as the wire is removed. This reel should be mounted two or three feet away from the vice which will hold the wheel brace used as the actual winding machine.

We found that the ¼in screw and nut through the coil was not satisfactory on its own as the spindle driving the coil. When the diameter of the coil increased and the amount of pull of the wire on the coil increased, the former slipped on the spindle.

To overcome this, we soft soldered a piece of 16-gauge tinned plate to the head of a ¼in steel screw (see Fig. 4). By putting two small wood screws through the two holes near the outside of this plate into the side of the coil former

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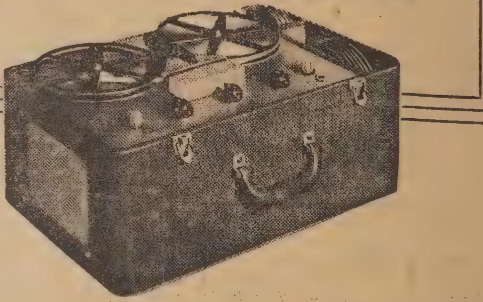

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cheek, a more positive drive was obtained.

The screw is put through the centre hole in the former, and the nut tightened up on the other end. The free end of the screw is then locked into the chuck of the hand drill, which should be held in the vice in a horizontal position.

The end of the wire is passed through the hole in the side of the former, which is the nearer the drill chuck. This wire is pulled through and wrapped around the drill chuck to keep it out of the way while winding. About nine inches of lead length is sufficient.

Winding is commenced, the wire being carefully fed on to the former to give a layer winding. It may be found that it is not possible to wind without some space between the individual turns, but these spaces must be closed up before the next layer is commenced.

This is best done by closing up the turns with a blunt, wooden stick when the end of the layer is reached, and additional turns wound on to fill up the space. The next layer must not be put on without this first one being done, otherwise the next layer will be worse.

TAPED WINDINGS

After the first two layers have been wound on, a layer of tape should be put on the winding. This levels it for the next layer and also limits the amount which will unwind if the wire is accidentally allowed to slip. Using this technique there should be no difficulty in building up the total number of layers required without resorting to scramble winding.

If exact layer winding can be maintained, the tedium of counting each individual can be avoided, the number of layers in the winding being counted instead. If the wire size and former size are made, the same as for our coils, the number of turns per layer will be 23 to 24, and the number of turns equal to this figure multiplied by the number of layers.

The amount of wire required for a single 4 mh coil is one pound if the recommended wire size is used.

The coil is finished with a double layer of insulation to keep the turns in position. The inside and outside leads should be left about 12 inches long so that they can be used for connecting the coils in the complete divider network.

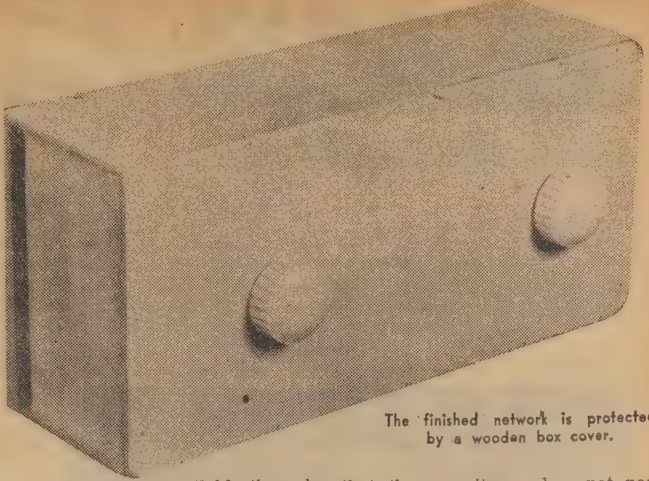
Having made the two coils, we assembled the complete network as recommended by Wharfedale for their three-speaker system. The diagram for this network is shown in Fig. 3 and a photograph of the complete unit is at the heading to this article.

VOLUME CONTROLS

The only feature in this network additional to those that we have already described is the inclusion of two potentiometers to control the level of the output from the middle and high speakers.

For these controls we used standard type wire wound potentiometer available from the usual sources. While the connection of these resistors does somewhat upset the theory that the network operates into a 15 ohm load, in actual practice it appears to work quite satisfactorily.

The capacitors we used were 8 mfd, 200 volt types, and we understand from the manufactures that these will be made available through trade channels. Equally suitable are the large block type which are available from disposals sources for a few shillings apiece.



The finished network is protected by a wooden box cover.

These capacitors are somewhat larger physically, as their voltage rating is 400 volts or higher, but electrically they should be quite satisfactory. We tested a few of them for capacitance. Some were under value, but could be made up by adding tubular condensers in parallel.

It should be pointed out here that the capacitance does not need to be of very close tolerance and the capacitors normally supplied for divider networks have a tolerance of plus 20 pc minus 10 pc.

The baseboard on which the network is assembled is 12 inches by 5½in and is made of 3-8in three-ply timber or similar thickness solid timber. This baseboard is big enough to accommodate the disposals type condensers if these are used. The actual method of mount-

(Continued on Page 119)

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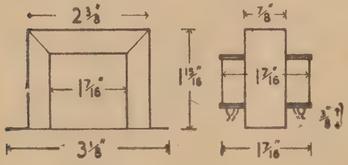

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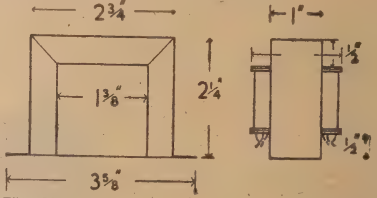

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FROM THE SERVICEMAN WHO TELLS

I have a mixed bag this month. Stories of "haunted" amplifiers, a portable that really rocked me for a few minutes, and some more stories about strange speaker troubles. Whatever else a serviceman's life may be, it is certainly never dull.

BEFORE delving into stories from the service bench this month I feel that I cannot allow to pass a recent news item in one of the daily papers.

This was to the effect that a movie projector used in a Newcastle school, had suddenly started to give forth the program being radiated from the nearby local broadcast transmitter.

In somewhat greater detail it seems that the projector had been returned to the local agents for a minor repair or routine overhaul, and that when reinstalled in the school building, had exhibited this partiality for the local broadcast program—a thing it has never done before. Apparently it still performed quite normally in every other respect.

FRANK AMAZEMENT

The head of the local repair organisation was reported as saying that he frankly disbelieved the claim until he had heard it for himself. Then he could only express amazement along with everyone else who witnessed the phenomena. The newspaper reporter seemed unable to make up his mind whether there should be a logical technical explanation or whether the whole thing was bordering on the supernatural.

Now I don't want to rob a newspaper reporter of a good and unusual story which, after all, is his stock in trade. However, I feel bound to point out that experiences like this are far from rare. In fact, they happen all too frequently, with results that can be annoying, embarrassing, or downright hilarious, depending on the circumstances.

Nor is the phenomena by any means new. My own first experience occurred many years ago (more than I care to think about really) when I was only just learning the finer points of the radio game. In those days I lived in a sleepy mountain town, where the only regular social activity was the picture show held in the Mechanics' Institute once a week.

Because of my interest in things electronic, I managed to get a job as projectionist along with a local "ham" and a couple of other radio enthusiasts like myself. Altogether it was a very pleasant and congenial atmosphere.

In fact, our activities were not confined to our home town. Several times a week we loaded the projection equipment into a car, packed some sandwiches for our evening meal, and trundled off to one of the other equally sleepy mountain towns.

One of these sites was within a mile or so of the local transmitter, and, after we had set up and tested the gear, we would munch our sandwiches in the projection room to the strains of music broadcast from the nearby transmitter. Perhaps there is nothing very unusual in all that, you say. True, except that we didn't have a radio, at least in the normal sense of the word.

All we did when we wanted a little entertainment was to remove the cover from the pre-amplifier stage, turn the gain well up, and, presto, there was the program!

Conversely, when it was time to start our own program, we put the cover back on the preamplifier (a trusty 57 type, which will give some indication of how long ago this happened) thereby effectively cutting off the broadcast program and restoring the equipment to its intended function.

Apart from the fact that the effect was rather novel and that we had a vague idea in the back of our minds that there was a logical explanation for it, we gave little thought to the matter. To us it was simply a handy trick which provided some free entertainment.

BUT WHY?

With the passing years I had almost forgotten about it until, comparatively recently, I commenced to hear stories from various colleagues about similar effects. These, together with the aforementioned news par raised the whole subject once again and posed the logical question: why does it happen?

Equally puzzling perhaps is why such effects appear to be on the increase, for one certainly hears about them far more frequently nowadays than when I screened the Squatter's Daughter.

There appear to be two reasons for this. One is the common use today of audio amplifiers having quite high gain, either for use with low output pickups or the equally low output from tape heads and microphones. The other is the increasing use of mobile radio telephones and the consequent appearance of quite reasonably powered base transmitters in various parts of the metropolitan area and the larger country districts.

"We've been sent to fix your binaural sound system." (Audio Engineering).

MOBILE TRANSMITTERS

Even more disconcerting is the fact that the mobile transmitter which forms the other end of the link is likely to park almost anyway and commence operations. When this happens, any sensitive equipment in the vicinity is likely to give forth the messages being transmitted—an effect which is extremely disconcerting to the listener, to say the least.

Which brings me to one of the main reasons why I raised this subject at all. Discussing the matter with fellow technicians I have collected several quite interesting stories. I pass them on for your enjoyment.

One of these concerns a mobile unit which had occasion to park in one of the city streets and send a series of very long messages back to the base. Apart from a few breaks there was an almost continuous stream of traffic for the best part of half an hour, most of it going out from the car.

It wasn't until the car driver was approached by a very worried-looking individual with a request that he might oblige by moving down the street a little that he realised that he was parked directly outside one of the large city theatres. According to the manager (for he it was with the worried look) the entire string of messages had been reproduced over the theatre sound system, completely wrecking the dramatic content of the picture being screened inside!

TANGLED SIGNALS

On another occasion there was a very important international golf tournament to be held at one of our most exclusive golf courses in a near city suburb. Extensive preparations had been made by various broadcasting stations to "cover" the event and the PMG's department had run temporary land lines to a number of points on the course.

All went well until a reporter from one of the newspapers ran his radio car in alongside the course and commenced to send "copy" back to his office. Unfortunately, he didn't realise that his aerial was only a few feet from one of the PMG lines carrying a commentary to a broadcast station.

Result: The reporter's version of the game, together with quite a number of unofficial comments, certainly

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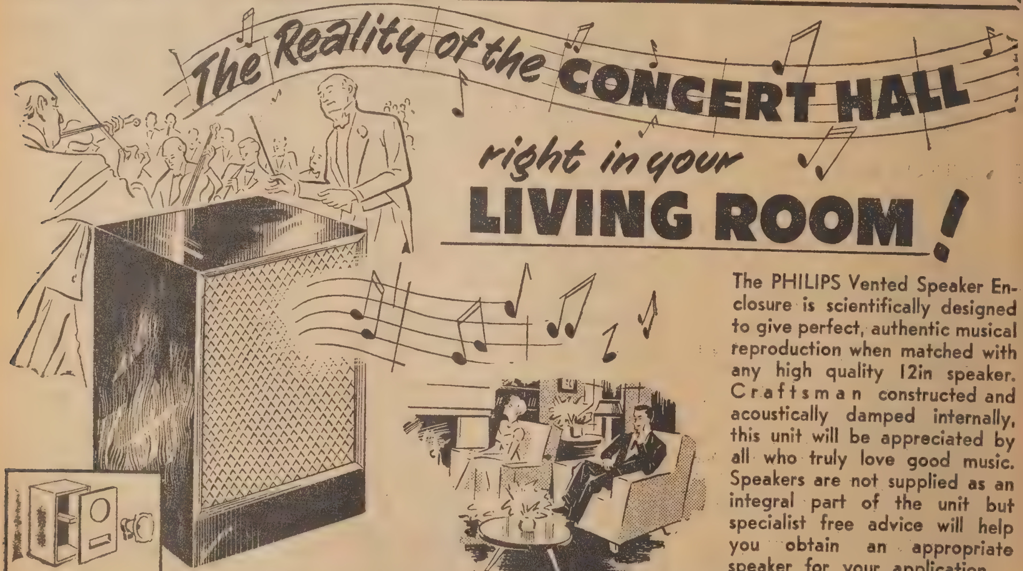
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not intended for publication, found its way into the PMG lines and out over the air via the broadcast station for everyone to hear.

In similar style are stories of taxi phones that broadcast their messages over the PA system at Mascot air terminal, motoring organisation maintenance trucks which tangled with the PA system in a well-known maternity hospital, and a base station that put its remarks "on record" on several dictating machines in nearby office buildings.

PLAIN SPEAKING

The embarrassing part about these situations is that the operators, being human, are occasionally prone to indulge in some pretty plain speaking when, for one reason or another, they are racing against time or harassed in other ways.

Provided such remarks are heard only by the person to whom they are directed, no one is likely to get very upset about it, even though it is strictly against regulations. However, when they are broadcast for all and sundry to hear it is quite a different matter and can lead to unpleasant situations.

But my prize story concerns a group of workmen who were engaged in painting a tall city building. One of the crew was rather deaf and used a hearing aid. All went well until they reached the roof of the building and had been working for some little time. Then the deaf member turned to his mate and said, "I say, are there any women around here?"

"No," replied his mate. "Why?"

"Well, there must be," persisted the deaf one, "I can distinctly hear a woman calling out from time to time. I can hear her quite clearly, can't you hear her?"

His mate assured him that he hadn't heard a sound anything like a woman's voice, and, when the rest of the crew were questioned, they also denied having heard anything. The upshot was that his mates decided that the deaf one was "off his rocker" and proceeded to tell him so with much good-natured chiacking.

To the deaf one the voice was very real and he began to wonder if he really was "off his rocker". To avoid further chaffing from his mates, he said no more, but continued to listen carefully for the mysterious voice. So far there had been little to guide him as to the possible source, the voice merely giving forth a single word such as "yes" or "right" at odd intervals.

MYSTERY SOLVED

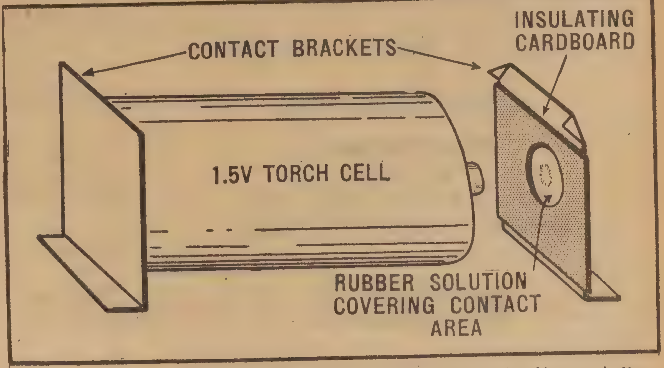
The first clue came when the voice commenced delivering a fairly lengthy message to someone obviously at some distant point. Hurrying down into the building the deaf one made a few inquiries and the mystery was solved.

The building housed a base transmitter and the deaf one had been working almost directly beneath the aerial which was at the top of a mast he had simply regarded as a flagpole. The signals had been picked up by his hearing aid and presented to his ear in exactly the same way as all other sounds he normally heard.

Needless to say, he lost no time in acquainting his mates with these facts and removing the grave doubts cast upon his sanity!

The natural query which arises out of all these stories is why they invariably involve audio amplifiers. It is easy enough to accept possible interference in a receiver, assuming a strong enough signal which will force its way through the various tuned circuits, even though they be tuned to some other frequency.

But an audio amplifier is another matter. At first glance it appears to be the last thing that one would expect to pick up RF, since no part of it is designed to handle such signals.



Rubber solution on the contact leaf so effectively insulated the filament battery that a portable set failed to operate.

The truth of the matter is that all we need in order to render RF signals audible (assuming they are strong enough) is a detector of some sort, followed by an amplifier, and a reproducer in the form of a headphone or loudspeaker. Devices over and above these, such as tuned circuits, RF amlifiers, superhet circuits and so on are mere refinements to make the equipment more useful and more choosey about the signals it receives. The detector, however, is essential.

Which still poses a problem, because a detector is usually regarded as a non-linear device, whereas a well designed audio amplifier is just the opposite, with every stage carefully adjusted to operate over its most linear portion. How then do we get detection?

ALL DISTORT

In the first place, no amplifier stage is completely free from distortion, regardless of the type of valve employed or the circuit in which it is used. Certainly the distortion may be of a very low order, but it is still present.

This means that if we feed an RF signal into such a stage, normally the first stage of a high gain amplifier, there will be some rectification. If the signal is strong enough, it will produce an audio signal loud enough to be heard, remembering that the audio gain following is normally quite high.

But even if the valve characteristic were perfectly straight the effect could still occur, because the characteristic would only be straight over a limited portion. This means that if we feed too strong a signal into a valve grid (be it RF or audio) we will drive the valve into the curved portion of its characteristic with consequent high distortion. If the signal is RF, this means detection and the production of an audio component.

So there it is. Make the signal strong enough and almost any stage will act as a detector and bring in anything from the children's hour to a reporter's description of a juicy tram smash.

And the cure? Well, frankly, I haven't had much opportunity to work on such problems, but it would seem that some form of RF by-pass on the first valve grid would almost certainly help. Considering that one can never be sure when a radio car is likely to park within range of one's equipment, it would seem good practice to include some such filter in most PA systems as a matter of course.

To reinforce the action of the bypass on the grid, one could well add an RF choke in the microphone lead and mounted close to the grid pin. Without knowing the exact frequency of the possible interference this would be about the best that one could do.

TUNED TRAP

Where the trouble was likely to be permanent, as from a base station, it might be possible to do still better by substituting a tuned trap in series with the signal input circuit.

A mains by-pass or filter may also help, in some cases, to remove RF interference entering the chassis by way of the power wiring.

Precautions along these lines are, in fact, only a repeat of those which must be taken with most modulators, otherwise they will readily pick up and detect the very signals they are impressing on the carrier. The result, needless to say, is hopeless feedback.

Attention to the microphone cable can often help also, assuming that all the above have proved insufficient. The first thing to appreciate is that a shielded cable ceases to act effectively as such at the high radio frequencies which are usually involved.

Because the length of the microphone cable can be a significant part of a wavelength, or even several wavelengths, of the signal involved the presence of standing waves on the shielding can easily cause the remote (microphone) end to assume a voltage relative to the inner conductor.

For this reason it is often benefi-

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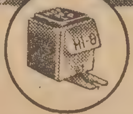

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al to earth the shielding at both nds and even at various points long its length. Again, an alteraion to the length will sometimes elp, whether it be to make it longer r shorter.

The best form of microphone cable s that regarded as standard by roadcast engineers. It uses two onductors and an outer shielding. he shielding forms no part of the ignal circuit and is earthed only t the amplifier chassis. The two ables carry the signals and are ed to a transformer with a centre apped primary.

ALANCED INPUT

This centre tap is earthed, which neans that the two leads are balinced with respect to earth. Any RF ignals which do appear on them will e equal on each and of the same olarity at all adjacent points along he pair. They appear at the two ends of the transformer also as qual and of the same polarity, with he result that they cancel and do ot induce any signal in the secondary.

Unfortunately all this assumes a ather more complicated set-up than ne is likely to find in the average PA system working from a simple rystal microphone—which is probably why many such systems are ften "caught out" when they set p in a strange situation.

On the other hand it could be the solution where a permanent PA system was troubled continuously by a nearby transmitter and the simpler methods I have outlined proved of no avail.

From the service bench I have a story of a portable. The owner hurried into the shop just before closing time on Saturday afternoon and dumped the set on the counter.

"Could you check the "B" battery for me please. I think it must be faulty."

I replied that I could test the battery but I asked him why he thought it was faulty. Had it had much use?

"Oh, no," replied the customer, "It's brand new, but I think I must have been sold a faulty one."

THE STORY

Bit by bit the story came out. It seemed that the owner had been using the set for several months as an AC set, it being one of the AC-battery variety. A few weeks previously he had returned it to the makers for a general overhaul from which it had returned apparently in first-class condition.

Now he wanted to use the set as a portable on the following day and had purchased a new HT battery and fitted a set of filament cells which he had on hand and which he was sure were all right. But the set refused to play on batteries, though it continued to function on AC. On this basis the owner reasoned that it could only be a faulty HT battery.

While I don't suppose it is impossible for a brand new battery to have a defective cell or similar fault I can't say that I have ever encountered such a case. For this reason I am always extremely sceptical about suggestions that a brand new battery is faulty. Invariably the fault turns out to be in the equipment and probably brought about by the act of changing the batteries.

HOW TO RE-CONE YOUR SPEAKER

A page from a cloth book provided the material to re-cone this speaker. Unfortunately the would-be repairman failed to appreciate how loudspeakers should work.

In this case I was more inclined to suspect the filament cells which the owner was "sure were all right" rather than the new HT battery. However, I started off by slipping the HT battery out of the case and measuring the voltage. On no load it showed a little over 90, suggesting it was most likely quite OK.

Switching on the set produced no signs of life and caused no observable drop in HT voltage, suggesting that there was no HT current. While this could be due to a number of causes I decided to check the filament cells first.

These were six standard torch cells conected in series as is usual with AC-battery sets, and a check across the opposite ends of the bank revealed no voltage. Commencing at the negative end I tested the first cell. This showed 1.5 volts, or close enough. Moving the positive prod up to the next cell produced three volts, but at the third cell there was nothing.

Up until now I had been measuring from the contacts between which the cells were mounted. Now I slipped the third cell out and measured it. It showed 1.5 volts. I checked the contact for tension, which appeared to me OK, and for corrosion &c (a frequent trouble where exhausted batteries have been left in a set) but the contacts appeared perfectly clean and bright.

MYSTERY

On the face of it the whole situation appeared just plain silly. As far as I could see there was nothing to prevent the brass cap on the cell from making perfect contact with the metal plate. Likewise the negative end of the cell appeared to be hard against its contact.

Apparently the rules of conductivity had suddenly gone on strike!

In an effort to clarify the matter I left the negative prod connected to the negative contact and managed to coax a piece of wire into direct contact with the positive brass cap on the cell. Under these conditions I was able to measure the normal cell voltage but immediately I transferred the positive prod from the wire to the contact there was nothing. By this means I established that the negative end of the cell was making good contact and that the fault was confined to the positive end.

INSULATING PAD

The only thing which appeared at all likely to cause the trouble (though I felt quite sure it wasn't) was a small square of insulating material which had been stuck to the metal contact and which had quite a large hole in the centre to permit contact with the battery cap.

It appeared that this insulator was a modification which the makers had fitted to the set during its recent overhaul. It was apparently intended to eliminate the slight risk of the contact shorting to the negative can of the cell in those types which were not very well protected at this point.

The only reason I suspected this at all was because the hole was slightly out of line with the detent in the contact. I couldn't believe it was enough to cause trouble but in the absence of any other obvious cause I was grasping at a straw.

THE SOLUTION

Reasoning that I could easily stick the thing back in place, I took a sharp knife, slipped it under one corner, and prised the insulator off the contact. Immediately I did so the whole problem was solved. The insulator had been stuck to the contact with a rubber solution. It was virtually colorless and had been spread quite thickly over the metal plate. It produced a thick film of transparent (and invisible) rubber over the vital contact area.

I'm afraid I said a very rude word.

Further examination showed that two of the remaining three cells were similarly insulated while the remainder could be made to fail in certain positions. It didn't take long to clean all the contacts and slip

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JA 8491 (6 LINES)

Engineered TODAY for TOMORROW'S requirements he batteries back into place, wherepon the set came to life and played erfectly.

Although the problem had been puzzling one while it lasted, the whole job had not taken so very ong and the customer was quite imressed with the way I had tracked own the fault. On the other hand am afraid the maker's repair deartment will have a black mark n that customer's estimation for a ong time to come.

Quite obviously the contacts had ot been tested after they had been nodified; a serious oversight on omeone's part and one which has ost the firm a lot of goodwill.

BUTCHERED" SPEAKERS

"Butchered" speakers are in the ews again. Strangely enough I reeived two letters, almost in the same nail, both detailing quite unique tories. Apparently these things go n cycles.

The first was from Messrs. L. & B f Wollongong, NSW, and was acompanied by a package containing he particular speaker in question. Messrs. L. & B. requested that I forward it to the agents for repair after had examined it. This I did, but took the opportunity to have it hotographed first. The picture is eproduced herewith for all to see.

Part of the story at least is best told in the words of Messrs. L. & B.'s letter:

"I am forwarding under separate cover a speaker for your inspection and would take it as a favor if you would forward it to Mr. ——, of ——, when you have inspected it.

"The call came to our workshop as distorted and low volume. When our man called, the owner did not beat about the bush, but admitted that the trouble might be in the speaker as mice had eaen the "cardboard' and he had repaired it himself.

"Our man took one look in the back of the mantel set and agreed that the trouble would be in the speaker! After going to such trouble to do an excellent job of re-coning it, it is a pity he used cloth for the cone and glued up the voice coil. From the nature of the cloth, I assume it is a nursery set.—Yours faithfully, &c."

Well, thanks Messrs. L. & B., and you may consider yourselves life members of the Serviceman's "Butchered Speaker Club".

Examining the speaker I could only agree that it was a pity the owner had not been more successful, because he certainly had gone to a lot of trouble. The material from which the new cone had been made was a fairly coarse woven cloth, which had quite obviously been a rag book of the type given to very young children with a predisposition to tear up the more normal variety.

A POOR CHOICE

Being a very soft cloth it was about the last thing that should have been chosen for a speaker cone. Yet the owner had obviously put a lot of work into making and mounting it. He had carefully salvaged the outer retaining ring from the old assembly and equally carefully used it to fasten the new cone.

As can be seen from the photograph he had also salvaged the small felt dust cover from the centre of the cone and fastened it in place. Where he had gone astray, however, was in attaching the cone to the voice coil. Either by accident or design he had allowed quite a liberal quantity of glue to run down into the annular gap, thus effectively "gumming up" the works.

SOME RESPONSE

Strangely enough, although the assembly appeared to be quite rigid to the touch, it was possible to get some kind of sound out of it; a fact which I established by connecting it to a set. As can be imagined it took a lot of power to make even a little noise and it was certainly not high fidelity.

Not much wonder the owner called the serviceman.

By contrast the other letter was from Victoria and from a schoolboy who has aspirations to become a serviceman some day. To be more precise it was from S. B., of Tottenham, Victoria. Well, best of luck S.B., and I hope you realise your ambitions, or even better them. In the meantime, if I may be permitted to offer some advice, you can best prepare yourself for the job ahead by concentration on such subjects as science and maths. The latter subject is particularly important.

But, to get back to the story. S.B. describes how he met his customer, "a kindly gentleman in the opposite seat", while on his way home from school in the train. Having learned that S.B. intended to take up radio when he left school, the kindly gentleman explained that he had a set which would not work and suggested that he might care to have a look at it. The rest of the story is best told in his own words:

SCHOOLBOY'S LETTER

"A couple of days later I saw the set, the owner very proudly showed me a cabinet he had made for it, the speaker being mounted on the top facing upward.

"After considerable trouble with no result, I plugged in a speaker from another radio, and the set performed very well. I first checked the primary of the output transformer, but this was intact, so I checked the voice coil. This proved to be open circuit.

"I checked to see if the leads were broken, and, as I did, I pushed the cone out a little so that I could see the voice coil. What I saw shocked me, the voice coil being cut all along one side.

"After close examination I found a neat piece of fingernail in between the voice coil and the pole piece. Apparently one of the ladies of the house had been trimming her nails and a piece of the nail had fallen into the speaker and, after a short time, had cut through the voice coil. Beat that."

Yes, S.B., that will probably take some beating and you may also consider yourself a life member of The Club.

It would seem that inverted speakers are a definite hazard, what with the previous story about the character who poured beer into such a speaker and this one pointing out the risk of finger nail parings. Goodness knows what they will get in them next.

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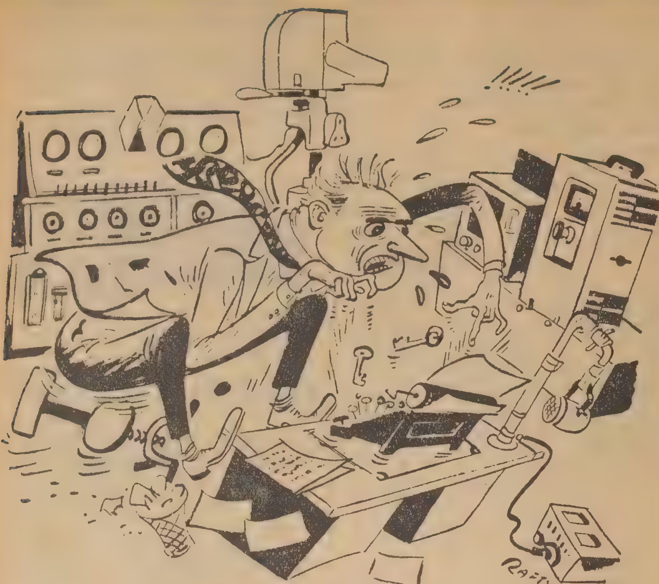
R & H



Let's Buy An Argument

Working for a magazine like Radio, TV and Hobbies may be a hectic kind of life but at least it's never dull. In addition to the ordinary routine of designing, building and describing radio gear, one has to be prepared for all kinds of questions, old and new, relating to popular science, aviation or almost anything!

by W. N. Williams

FOR example, we have an urgent plea to hand from a reader in Longreach, Queensland, who wants to know what would happen if the guard of a railway train were to fire at the driver with a rifle having the same muzzle velocity as the train.

"What we wish to know," asks our correspondent, "is whether or not the bullet would hit the driver?"

AN ARGUMENT?

I gather from the use of the word "we" that two or more people up in Longreach have been enjoying an argument on the subject. And since my name is rapidly becoming synonymous with the word "argument", I'm supposed to supply the answer.

Actually, the conditions of the question rather amaze me. Either there's something radically wrong with the rifle in question or Queensland trains have been speeded up quite a deal since I last saw them.

Read the problem again and you'll see what I mean.

However, let's compromise and assume that the rifle has a muzzle velocity of 100 mph and that the train is also travelling at this same speed.

The guard, with malice aforethought, draws a bead on the luckless driver, who must presumably be leaning out into the slipstream to shoo cattle off the line. Otherwise he wouldn't be readily visible.

When the homicidal guard finally presses the trigger, the bullet will emerge at a speed, relative to the barrel of 100 mph. But since the said barrel is already travelling forward at 100 mph, the total speed of the bullet relative to the ground will actually be 200 mph. It will be going a lot faster than the train.

Quite obviously, if the bullet can keep going long enough, it mus overtake the driver and make him realise that staff relations on the train are, to say the least, rathe strained.

I think that should answer tha question.

Just a few weeks ago, we had the problem in reverse — concerning the tail gunner in a bomber who fires machine gun bullets at an attacking fighter, the bullets allegedly having the same muzzle velocity as the forward speed of the bomber.

DRIBBLE OUT?

"What happens to the bullets," asked our correspondent. "Won' they just dribble out the end of the gun and fall harmlessly to the ground?"

Most decidedly not. In the first place the bullets wouldn't "dribble" out. They would emerge spinning violently from the influence of the rifling in the barrel. They would begin to fall toward the ground, to be sure, but at no greater rate than they would fall anyway, if travelling forward at their normal speed.

If the aim were fortunate (for the gunner) the bullets would fall right into the path of the attacking fighter and have their intended effect.

As far as the final impact is concerned, the speed of the missile relative to the target is what counts, irrespective of whether one or both are travelling.

So I'm told anyway.

From time to time we are even questioned about that classic of all campfire puzzles; about the man who stands gazing at a picture on the wall.

Says he: "Brothers and sisters have I none but that man's father is my father's son!"

NO PROBLEM AT ALL

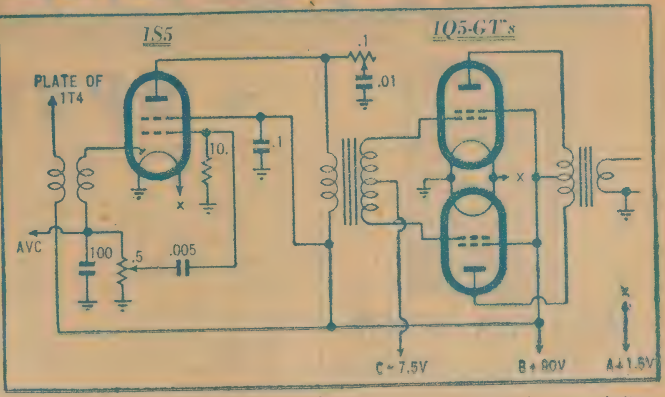
Simplify the expression a little and it's as plain as a pikestaff that the man is looking at his own son's photograph. But you try to tell a bushman that!

What all this has to do with radio, I can't imagine, unless perchance it comes as a welcome change. But what am I saying?

"Excuse me, sir, but your inhibitions are showing!"

In the recent discourse in these columns about class-B abplifiers — what they are and how they work— I thought we'd covered most of the loose ends that worry people. But not a bit of it.

ANOTHER CLASS-B AMP. PROBLEM



A correspondent wants to know what's wrong with this circuit for a class-B battery powered audio end. It's simple and ought to be able to give 1½ watts—or so our correspondent apparently believes. What do you think?

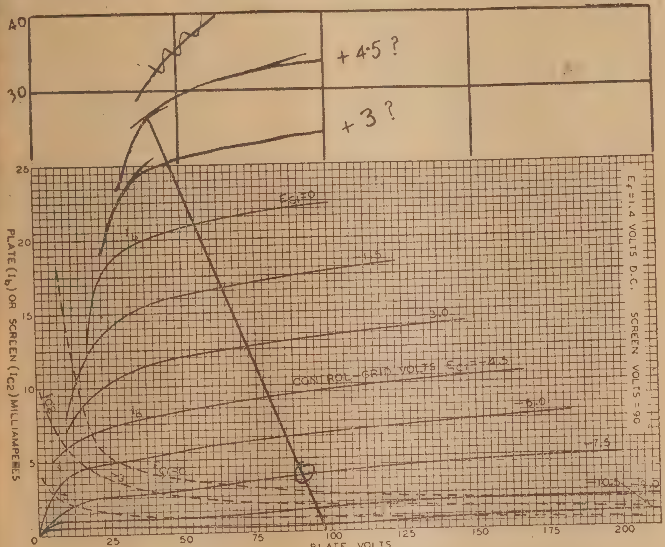
A reader from Earlwood, NSW, sends in a circuit for comment — and it certainly needs comment. I quote:—

Could you please examine this circuit, intended as a class-B output for a set I am making. Is the bias for the output tubes correct for class-B? Could you please tell me if negative feedback is required; if so would you mark it in please? Last of all, could you please tell me what plate-to-plate impedance I would need for about 1½-watts output?

It sounds all so routine but the trouble is that to answer these questions in full would require a lot more information than is readily available. To begin with, I have never seen published anywhere class B operating conditions for 1Q5-GT or similar valves. Nor have I seen class AB2 conditions. That makes it hard.

The curves aren't much help, either, because they are not drawn for positive excursions of control grid signal.

Does this mean that no one envisaged the use of these tubes under class B or class AB2 conditions, or does it mean that the drive requirements would be such as to render the scheme uneconomical?



We couldn't find any data for positive grid excursions of the 1Q5-GT or any other comparable battery pentode. If extra lines sketched in like this mean anything at all, they would suggest that a worthwhile increase in power over class-A would only be possible if higher operating voltages could be used.

Maybe the tubes are unsuitable for the job. Perhaps there's some limitation on peak plate current, imposed by the electrode structure or by the filament emission?

Would it be permissible to increase the initial plate and screen potentials, in search of higher power, seeing that the standing currents would be low?

The ratings have no answer to these vital questions and the only recourse would seemingly be either to discover someone who knows the internal workings of a 1Q5 or a similar valve or else to try and establish one's own conditions and limits.

One can always do this, of course, but there is no guarantee that the manufacturer will see eye to eye if there is any subsequent argument about valve failure and replacement.

Failing one or other of these protracted investigations, one can only look at the valve curves and speculate.

It's easy enough to sketch in extra lines where the positive bias curves might fall—but would they? And how far can you take them? Plus 1.5 volts, plus 3 volts, or what?

The best one can say is that if the valve does have a useful positive-bias region the knee of the curve (or curves) would lie "somewhere up there". Then, drawing a loadline through a suitable operating point to "somewhere up there" might suggest a slope of about 2000 ohms.

The plate-to-plate load would be four times this, or about 8000-10,000 ohms.

The suggested operating point at about 7.5 volts would be a reasonable choice, although it could only be verified practically or by a rather lengthy graphical investigation. I did a few such investigations years ago, when concerned with valve application data, but it isn't the sort of thing one tackles without a very good reason and plenty of time.

As for power output, I'm inclined to think our friend is being very optimistic in expecting three times as much power in class-B as one could expect from the same two valves operating in class-A. Taking everything into consideration my tip would be an output power of about 0.75 watt at the very most.

EXTRA POWER

Ha! A 50 pc increase! Half as much power again! An extra quarter watt!

But alas and alack. It only amounts to three decibels, a barely audible increase in power output. Could this be the reason why nobody has bothered with class AB2 battery pentodes?

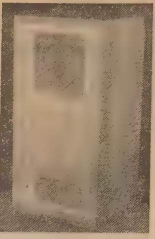
The foregoing figures assume optimum drive conditions, of course, and here our friend is again somewhat astray. To be sure, he is using a driver transformer as we specified and full voltage on the driver valve, but the valve is connected as a pentode.

Therefore, transformer or no transformer, it cannot possibly meet the basic requirement of a class-B stage for a low-impedance driver. A pentode, you see, has a high plate impedance.

At the very least the 1S5 would have to be connected as a triode to lower its output impedance, after which it might or might not supply enough power to drive the 1Q5s.

Then again, with a full 90 volts on plate and screen, it wouldn't be used with zero grid bias or grid-leak bias as shown, these conditions

MOTOR SPARES LTD



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Sizes for 12in speaker **37/6.**
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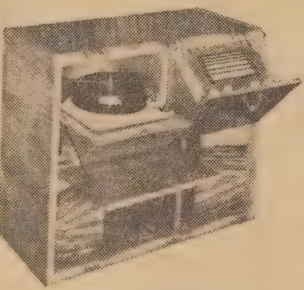

RADIO CABINETS

Radio Cabinets as illustrated. Latest type with slide-out changer panel and tip-out radio set, panel fitted with velvet action door closer. Record storage cupboard. Overall size 35in long, 31in high, 16in deep. Set panel 16 x 8. Baffle cut for 12in speaker; Changer and set panels uncut. Colors available: Walnut, mahogany and blond.

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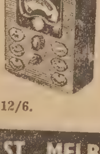

Chieftain Multimeter New model using 100 ohms internal resistance, meter sensitivity 1000 ohms per volt. Voltage readings 0-15, 0-150, 0-300, 0-600 DC. Ohms 0-100,000. This is a pocket size meter, ideal for the Electrician Serviceman, amateur, motor mechanic and handyman. Price only **£4/12/6.**

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    Filament volts 4 at 1.1amp.
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547 ELIZABETH ST., MELBOURNE ALSO AT — ALBURY ARARAT BAIRNSDALE BALLARAT BENALLA BENDIGO BROKEN HILL COLAC DANDENONG ECHUCA SALE FRANKSTON GEELONG MILDURA SHEPPARTON ST. ARNAUD WAGGA WANGARATTA WARRAGUL pplying only for resistance-coupled mplifier service. A glance at the urves indicates that, as a full-scale ass A amplifier, something like -2 -3 volts bias would be required the grid, to ensure something like ptimum plate current.

Of course, the 1S5 could be used s a pentode driver, if feedback ere applied around it to lower its fective plate resistance. But there re at least two serious objections this idea, as the circuit stands.

To begin with the combined effect f feedback and an isolating circuit vould drastically reduce the audio ain, which is already too low. The standard" kind of class B amplifier as three stages—preamplifier, driver nd output and our correspondent vould have to conform with this ractice before he could reasonably tart talking about feedback.

EVERAL CATCHES

Actually, the whole subject of eedback is a rather complex one, vhen applied to class AB2 or class B amplifiers. It has to "tame" the utput stage, as in any other amplifier, but that is not all. The driver stage is likely to be hardly less emperamental, because it is operating into a transformer which is not oaded on some parts of the input cycle, but heavily loaded on others.

Then there is a limit to the amount of feedback which can be applied to the amplifier, with stability, because it has to go over two transformers—driver and output—and suffer that much extra "accidental" phase rotation.

Furthermore, although I've never had experience on this point, I believe that strange things can happen to the feedback at the transition points — that part of the signal cycle where the load current is changing over from one output valve to the other.

However, we're getting in a lot deeper than the original query warrants and it's time we calld a halt. But enough has been said to indicate the need to modify and enlarge the original circuit.

The end results would be an audio system much more complicated in its circuitry and much more modest in its performance than originally envisaged.

Sorry, T.H., but we can't be more encouraging than that. Whether it's worth pursuing further, only you can decide.

BATTERY PROBLEMS IN PORTABLES

In your August issue you publish a letter received from one of your New Zealand readers on the subject of portable radio design. This letter makes reference to the type of receiver usually intended for AC mains operation in which the valve filaments are connected in series.

Your reader's queries with regard to the effect of "A" battery voltage on the discharge current taken from the "B" battery have been adequately answered in this issue, but we believe it would be desirable to lay some emphasis on the reduction in undistorted power output that is brought about by combinations of low "A" battery and high "B" battery voltage, and vice-versa.

We have tested most of the portable radios of this type at present on the market, and it has been found that, provided both "A" and "B" battery voltages decrease uniformly, the maximum undistorted power output is obtained throughout the useful service life of the batteries.

However, a combination of high "A" battery voltage and low "B" battery voltage invariably leads to reduced power output, since the output valve is seriously over-biased in this condition, and the effect is usually even more serious in the case where a low voltage "A" battery near the end of its effective service life, is used in combination with a new "B" battery.

Under these conditions the filament emission of the output valve is reduced, and there is a serious increase in distortion, which limits the available power output In our experience it has been found that at low "A" battery voltages the undistorted power output is considerably increased by reducing the "B" battery voltage.

Because of this situation it is desirable that both "A" and "B" battery voltages should decrease fairly uniformly, and there are thus some advantages in using a combination "A-B" pack battery such as the No. 753 type, since with careful design it is possible to obtain a good balance in service life between the "A" and "B" sections.

Your correspondent refers to the No. 739 battery as having an estimated life of 60 hours at the most and he bases this conclusion on the relative size and number of cells in this battery as compared with the No. 950 battery.

We would point out, however, that the service capacity of a dry battery depends upon the cell grade as well as the size of the cell, and furthermore, the service capacity does not bear a linear relationship with the size of the cells used. The No. 739 battery is designed for portable radio "A" service at a nominal discharge current of 50 mA., and the cell grade is chosen to give the maximum service life to a high end-point voltage in this type of application.

In view of this, the service life of the No. 739 battery, with two hours daily use, is more than twice the figure quoted by your correspondent.

Even so, this does not give balanced service life with two No. 482 batteries which were originally intended to be used with a No. 745 "A" battery where the balance is good.

Actually the No. 739 battery was introduced at the request of one of the local radio manufacturers, and it should be kept in mind that in using this battery in conjunction with two No. 482 batteries, two "A" batteries should normally be used during the life of each set of "B" batteries.

Apart from these two points, however, we would say that our experience in testing commercial portable radios supports the conclusions you have drawn regarding the effect of reduced "A" battery voltage on "B" battery discharge current, and we concur with your view that reduced "A" battery voltages do not increase the "B" battery drain by more than a negligible amount under practical operating conditions.

Yours faithfully,
P. H. ADAMS
(Products Engineer,
Eveready Australia Pty. Ltd.)

BATTERY SETS

From the Eveready Company comes the letter reproduced on this page. It follows the recent discussion in these colums about the effect of A battery voltage on high tension drain.

You may recall that a reader from New Zealand, quoting another magazine, suggested that a low A battery voltage supplying a series filament string, would mean low bias on the output valve. This valve would then presumably draw higher current and impose more than usual drain on the high tension battery.

We suggested that the tendency to draw higher current would be largely offset by the reduced filament emission and the consequent change in the valve's apparent characteristics.

Fortunately (for yours truly), the Eveready Company concurs with this view, apparently having conducted a good many tests along these lines. Their further findings on the relationship of power output to the balance of voltage are specially interesting, however, and warrant careful consideration.

It is surprising to note that a valve running with low filament voltage can apparently deliver more power when its plate and screen supply are REDUCED proportionately. One might envisage that the benefits of a full high tension supply might not be realised with a low A-voltage, but the relationship of more volts—less power is surprising.

However, if it weren't for such things, friend Ripley would be out of a job.

Does this mean that all future R, T and H portables will be designed with strictly balanced A and B battery life? It might, but then again it might not!

When you're juggling things around to get as many parts as you can into the smallest space possible, with dial, knobs and speaker poking through at the right places, the choice of batteries depends on more than purely electrical considerations.

If efficiency were the only criterion of design, we'd begin by putting in a heavy-duty 12in speaker, thereby assuring plenty of acoustic power. After that there'd be room around the place for as many batteries and circuits as one could possibly wish for.

The only trouble is that nobody would want to build such a set! Leastwise, I don't think so.

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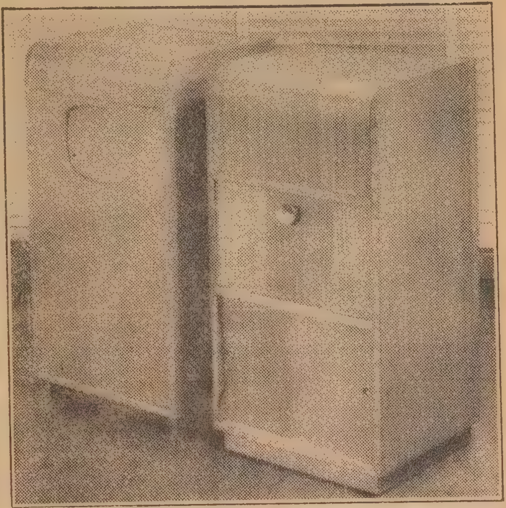
TRADE REVIEWS AND RELEASES

MATCHED CABINETS FOR HI-FI RADIO SYSTEMS

While many enthusiasts have no difficulty in building up elaborate receivers and amplifiers, the provision of suitable cabinet work is often a problem. A pair of matching cabinets recently announced by Amplasound will therefore be welcomed by many readers.



The two cabinets may be placed side by side or dispersed according to the layout of the room. They will house a complete Hi-Fi sound system and provide storage space for over 100 records.

THE cabinets have been designed with a view to housing either ommercial equipment or home-uilt "Playmaster" gear. They are herefore much more readily adaptable than standard radiogram cabinets which, in any case, seldom provide roper baffling for the loudspeaker.

The main cabinet pictured on the ight is divided into three compartments, as follows:

The top section has a sloping panel uitable for mounting most control units and/or radio tuners. Access is gained by a hinged door. The main amplifier is placed on a shelf provided for it at the back.

The mid-section is a pull-out gramophone drawer large enough to accommodate a changer or most motor-pickup combinations.

The bottom section is a record storage compartment with two sliding doors, providing storage space for approximately 120 records.

Two distinct timber tonings are available, namely a modern honey-toned maple veneer or a walnut, where a darker finish is required.

The matching vented enclosure, pictured on the left, can be supplied to suit a variety of 10 and 12in speakers.

It is braced and padded internally and features an expended gold anodised grille, for minimum high frequency loss. The vent is concealed, being at the floor level, while the eternal volume of the cabinet in 6 cubic feet.

Overall measurements of both cabinets are 38in high, 19¾in across the front and 17in deep.

Price for the record player cabinet is £32/15/- and for the matching speaker cabinet £28. The cabinets are available separately if required.

They are available only from the Amplasound Company, 126 Buckingham St. (cnr. Cleveland St.), Sydney.

MINIATURE CONTROL FROM IRC

To meet the anticipated demand for a miniaturised potentiometer, Messrs. Wm. J. McLellan have added to their range the type "Q" control pictured below.

THE new control measures only 15-16ths of an inch in diameter and is therefore ideally suited to use in small receivers and amplifiers or in any application where small size is important.

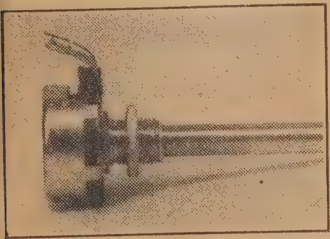
The control is manufactured to rigid specifications and has been specially designed to withstand local temperature and humidity stresses. It is available in a complete range of values and can be supplied plain or tapped and without a switch. Release of the control with an in-built switch is anticipated later.

The manufacturers claim that the resistance element is of particularly efficient design, the resistance element being permanently bonded by heat treatment to a phenolic laminate.

Electrical rotation of the control is specified as 300 degrees, a silver-plated brass collector ring, with high-stress alloy contact providing connection to the centre lug.

Power rating for the element is ¼-watt, with voltage ratings of 500 max. volts across the element (where dissipation is not exceeded) and 1000 volts between the element and ground.

Supplies of the new potentiometer will be available through trade houses. Detailed specifications from the manufacturers, Wm. J. McLellan and Co., 126 Sussex St., Sydney.

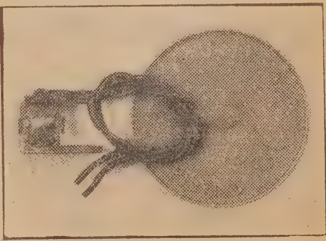


The new IRC type "Q" control, shown here full size.

MINIATURE HEADS FOR STRIPED FILM

MINIATURE heads are now available locally for converting substandard film projectors to magnetic sound.

Under the trade name "Photovox", the heads are manufactured in Italy and are claimed to be the smallest magnetic heads in production anywhere in the world. They measure approximately 0.3 x 0.35 inch, excluding the mounting bracket.

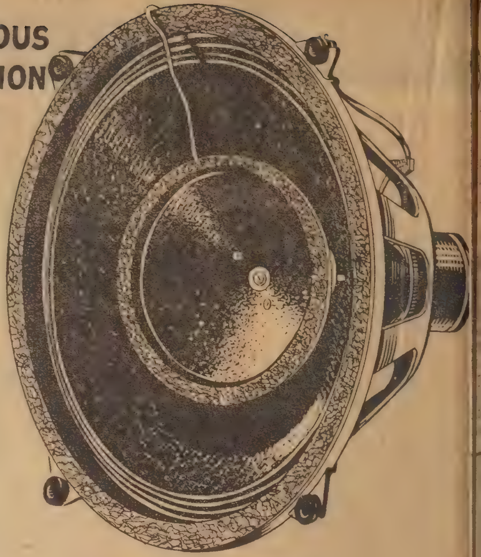


One of the miniature heads compared in size with a penny.

On a basis of 24 frames per second (16mm film), the heads are credited with a frequency response of 50-8000 cps and 50-6000 cps at the silent speed of 16 frames per second.

Supplies are available ex-stock from Magnetic Products, 4th Floor, 484 George St., Sydney. Retail price for the record/playback head is £5, an erase head being available also at the same price.

SABA EUROPES MOST FAMOUS 4-SPEAKER COMBINATION



Offering for the first time in Australia, the famous SABA 4-Speaker combination as fitted to the sensational SABA 3D series receivers. The speakers are particularly designed for HI-FI, low power operation.

Specification:

4 frequency-matched speakers 2 x 10in, 2 x 4½in
Frequency range 50c (-5 DB)—15,000 c.
Combined Voice Coil Impedance: 2, 5 ohms.
Power handling capacity: (max.) 12 watt.

Supply: Strictly limited.

Price of the 4-speaker-combination including tweeter condenser **£30**

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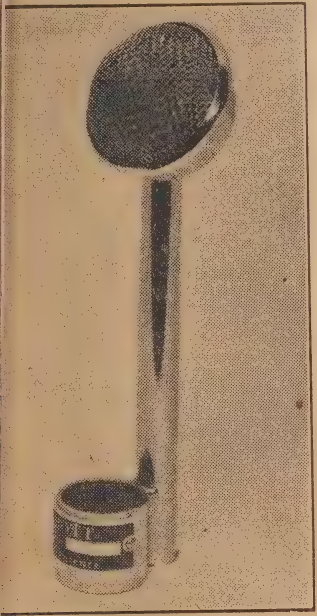
The crystal microphone maintains its popularity against all comers, particularly in the low cost field where crisp quality and comparatively high output is a big advantage.

ICTURED below is a newly-released type made by J. K. Ibbott, 430 Bourke St., Melbourne.

Its unique feature is that the head easures little more than one-inch ross, making it one of the small- crystals for every-day use.

The complete microphone is made Ibbott, including the crystal itf, which is thoroughly impregted against the effects of moisture



An Ibbott miniature mike.

nd sealed up inside the diminutive ase.

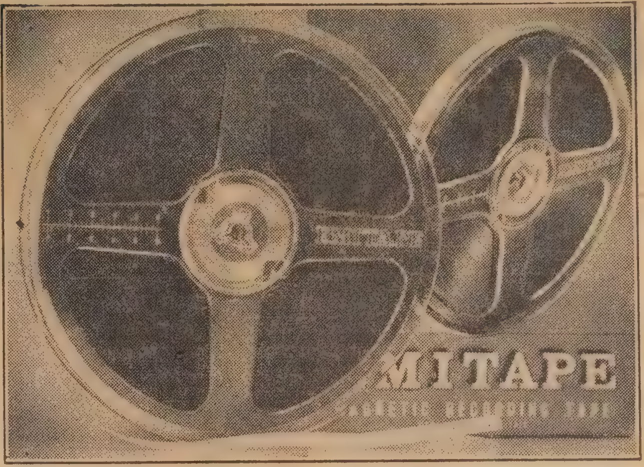
This microphone, which retails for nly £3/13/-, is mounted in a hrome-plated holder, the base of vhich is threaded for attachment o the standard microphone stand.

Its small size makes it useful in nany circumstances where a more onspicuous type would be unsuitble. It should be ideal for many ublic address applications, amateur tations, &c.

The front cover can easily be emoved, so that a small quantity f cotton wool or cloth could be nserted as an acoustic filter. As vith most crystals, this flattens the esponse where a sharp characterisic is not required.

It comes with six feet of cable ttached.

EMI TYPE 77 RECORDING TAPE



A reel of the new Emitape and its attractive box packing.

The new "Emitape" recording tape, 77 Series, has many advantages over the earlier H50 type. It is thinner and stronger, and has much superior electrostatic qualities, being almost immune from frictional static.

IT, therefore, winds very smoothly, and shows no tendency to buckle or harden in use.

Its sensitivity is higher, being approximately 8 db above the sensitivity of the H50.

This is the professional grade. The standard grade, known as series 88, is made of the same magnetic oxide and film base, has the same electrical and physical properties, but is for use with equipment which does not require the extremely fine tolerances for which the 77 is designed.

The tape is very strong, with a tensile strength of 7½lb per ¼ inch width, and an elastic elongation at 1lb load of less than .5 pc for a 15 second application. Its yield point is 4½lb and recommended operational tension is 3oz.

In use the tape gave us excellent results, indicating that it is well suited to the most rigorous employment.

This tape is used in making all HMV, Columbia and Parlophone records.

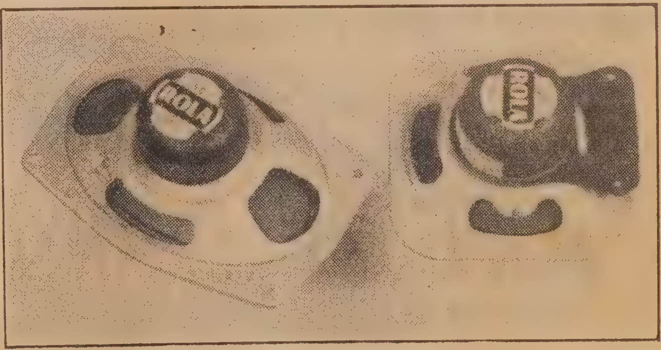
NEW LINE OF MIDGET ROLA SPEAKERS

THE Rola Company have released four new speakers of particularly neat appearance and high efficiency, two of them being standard 4-inch types, and two 4-5 inch oval types for use where cabinet design allows a somewhat larger cone area.

Model 4C has the smaller magnet of 7500 gauss, and is intended mainly for AC sets. Higher efficiency of about 3 db is provided by the larger magnet of the 4F, which has 9150 gauss. Electrically they are otherwise the same with 3.5 ohm voice coils.

The elipticals have similar acoustical efficiency and power rating of 2½ watts. Resonance is at 125 cycles and response from 120 to 6500 cycles.

Prices less transformer range from 31/2 to 41/11 retail, which makes them a very attractive buy.



Two of the new Rola speakers, 4F and 4-5F.

OFF THE RECORD — NEWS & REVIEWS

Two fine violin concerto recordings have been released this month—one of the Beethoven and one of the Brahms. Neither is beyond criticism, but both are good enough to be numbered among the best. The Menuhin Beethoven in particular has been eagerly awaited.

by John Moyle

As I have said on other occasions, the Beethoven might be considered the greatest of the violin concertos, but the Brahms makes big claims to be the most beautiful. It is a work which must find a place in any representative collection.

BRAHMS—Violin Concerto in D Major Opus 77. Played by Johanna Martzy and the Philharmonia Orchestra, conducted by Paul Kletzki. Columbia 330CX1165.

This record came as a surprise, mainly because, in an extremely hot field of famous men, such as Milstein, Stern and Oistrakh, a woman fiddler should come through with a performance which, for pure musicianship, will hold its own with any of them.

As it is, were it not for the fact that I haven't at the moment any of the afore-mentioned versions for comparison, I would be inclined to pick it as the best Brahms to date. On a count-back, it still could be.

Firstly, Johanna Martzy is a most competent performer. She is not of the machine-like technical school to which most of the big names of the day belong, but she is still equal to all the many problems posed by this difficult concerto. She has no knife edges, but she plays with full authority and vitality, and a strength quite unusual for a woman.

Secondly, despite the above, she displays a musical sincerity the appeal of which is immediate. She is completely immersed in the music. At all times she is an interpreter, never an exhibitionist, never a school-marm, always in command.

And lastly she produces a full, warm tone, as much the result of her own efforts as it is due to a very fine instrument.

Even in the many high passages, which so often deteriorate into shrill squawks, her tone rarely thins out or falters. Except possibly for a few bars near the end, where it is very hard not to get a bit lost, she maintains her identity like a bright thread against the orchestra with a sure musical line, every entry clean-cut and certain.

Although the balance is good, the recording is not a forward one, and I think it gains thereby. This is not a work which sits comfortably at too close range. Its size and breadth need room and some distance to live and expand.

Do not miss hearing this disc if you are in the market for Brahms. Others may impress you as being more brilliant, but I doubt whether any of them are more musical or will wear better than this one.

HAYDN—Quartet in F Major, Opus 3 No. 5. Quartet in D Minor, Opus 76 No. 2. Played by the Quartetto Italiano. Columbia 33CX1230.

There is without doubt much fine playing and recording in this record. At times both reach virtua the highest standard—good enou to equal anything I have heard discs.

And yet it is not fully satisfyi

The players go through the actic but so frequently seem to miss t effect.

Their efforts are not aided by d tectable and somewhat disconcerti changes in recording level and pre ence, all the more noticeable becau on the whole the recording is qu forward.

Some of this variation in dynami is due undoubtedly to the playe themselves, but I don't think th are always to blame.

In the last movement of the Major for instance, there is a ta join in which a subtle change the character of their playing intr duces a discontinuity which shou not have happened.

And in the Andante Cantabile the same quartet, so well know the music drops to a low level whi gives no other impression—certain not one of delicacy and charm whi should come from the change mood.

In fact I was almost led to su pect that an ability to play loud or softly, with an occasional an sometimes unnecessary change tempo, comprised their full armor

Against this must be weighed recording which is generally goo and often remarkably vivid, and quiet background so low as to negligible.

And the performance never drag despite long breaks between th movements.

I did not like this record as we as the Beethoven Opus 59 No. 3 re cently reviewed, but I cannot dis miss it on these grounds. It coul impress you quite differently.

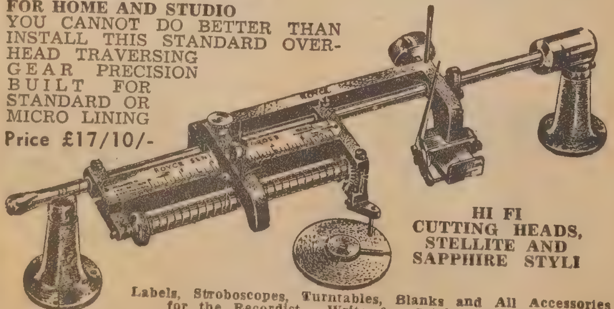
CHOPIN—Les Sylphides, Ballet Suite. Played by the Philadelphia Orchestra conducted by Eugene Ormandy. Philips S06607R.

This is a very nice bit of record ing. Everything is clean and clea the solists are impeccable, the ton is generally rich and lush, the musi well turned, the handling firm.

But it sounds too matter of fac for me, not delicate enough, an with little of the ballet spirit to it

The impression isn't improved b the break between the various sec tions. However appropriate suc breaks might be in the theatre, the are most irritating when listening t the music as such, particularly whe applied to the extremely short in troduction, for instance, which hardly begins before it ends.

Apart from this the record ha almost everything to recommend it The reverberation I thought wa handled most skillfully. You will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note how it holds the strings together and allows the tone generally to blend without spoiling that instrumental clarity I have already mentioned.

It certainly allows the Philadelphia orchestra to show its impeccable paces.

Not really a wide range disc, although its good balance and presence makes it sound that way. Neither bass nor highs are extreme. The surface is inaudible.

BERLIOZ—Symphonie Fantastique Opus 14. Played by the Philharmonia Orchestra conducted by Herbert von Karajan. Columbia 33CX1206.

Not the least remarkable thing about the genius of Berlioz is that he lived in the time of Beethoven. And yet no greater contrast could be imagined than that presented by the musical outlook and technical mastery of these two men.

Nothing like the music of Berlioz has ever been written, nor was it ever paralleled until much later. Even then we must come forward to composers like Stravinsky and Mahler, a contrast in itself sufficient to demonstrate the enormous range of Berlioz. It is not even safe to mention only a few of those he influenced for fear that too many others would be left unspecified.

The Symphonie Fantastique is possibly the best Berlioz for a collector who wants representation in his library, and of those available this disc must be recommended as extremely hard to pass over.

Despite the composer's suggestion not to take his program too seriously, I can never dissociate it in my own mind from the wild, drug-impelled dreams of the rejected lover, ranging from nightmare and rapture to final destruction by the headsman's axe for murdering his beloved, accompanied by the diabolical mockery of ghouls and demons who celebrate his end.

Both the performance and the recording are outstandingly good.

Of the performance its massive quality will impress you most.

Only in the quiet third movement did I feel Karajan's grip anything but firm and sure.

Maybe it doesn't shriek and gibber with quite as much point as it might, but the ominous power and weight of sections such as the March to the Scaffold more than make up for this.

Here we have a clarity and ballance of recording in the highest order, impressive in every way, doubly so if your equipment is able to pound out the power, and show up both the clarity of Berlioz and the beautiful instrumental definition of the orchestra.

The surface has a few crackles, but is generally very quiet.

A fine disc which earns high praise in every respect.

BEETHOVEN—Sonata No. 8 in C minor Opus 13 (Pathetique). Sonata No. 23 in F minor Opus 57 (Appassionata). Played by Edwin Fischer. HMV OALP1094.

Edwin Fischer isn't a big enough pianist to make these two sonatas sound the way they should.

He is extremely sensitive to light and shade, and he produces some very beautiful sections in themselves. But he is not capable of tying them all together so that the finished shape has the integrated outline Beethoven planned.

Where strength and firmness are required he too often produces only the appearance of it, and then without conviction. Frequently he languishes where urgency is needed—he concerns himself with shaping phrases and extracting tonal effects, apparently oblivious that he has completely spoiled the musical line in the process.

The net result is often fussy. His work can't stand comparison with the authoritative, broad-browed magnificence achieved by Gieseking, for instance, in his record of some months ago.

You will never get the idea that Gieseking is fiddling about, striving to underline an effect, or charging a phrase to overpower the ear rather than stimulate the soul.

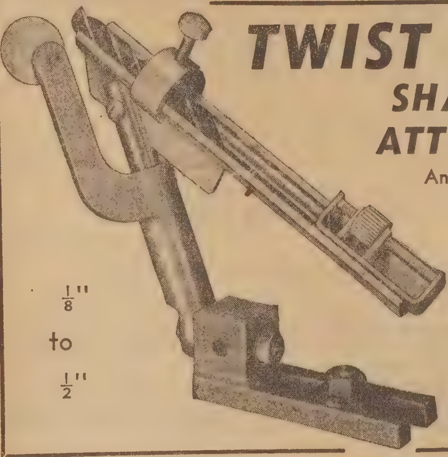
For despite the beating they have received from incipient pianists, and which no doubt they will receive until the end of time, these are truly magnificent sonatas. Just how much so we are not always aware, until a master pianist puts his hands to them.

For this reason I listen to Fischer not without some pleasure but without any of the inner lift the music can give.

The piano tone is full and forward, which contributes to the effect of power which isn't really there. It is achieved by a fairly close mike technique, but the record is cut at a lowered amplitude, apparently to avoid overcutting on heavier passages.

Despite this, the tone isn't always clean in the Pathetique, although the Appassionata is comparatively successful. Its surface noise, too, is the lower of the two.

You may like your Beethoven this way—many do. But for me it isn't big enough to hit the mark. Which is where I came in.



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STRAVINSKY—Duo Concertant for Violin and Piano. SCHUBERT — Fantasia for Violin and Piano Opus 159. Played by Colin Horsley, piano, and Max Rostal, violin. HMV OCLP7501.

This is a strange combination musically, or should I say a strange contrast. On the one hand we have Stravinsky trying to make his violin-piano combination sound quite different from any previous work, and Schubert presenting rather conventional music in which there is much melody and charm but no surprises.

The performance on the whole is competent and given with authority. The pianist is somewhat reminiscent here of Badura-Skoda, and Rostal's playing has freedom, good intonation and mostly a fine tone.

The forward recording results in good presence, but also shows up a hardness in the upper register and a rather unpleasant edge, particularly noticeable on some sustained notes in the Schubert.

Instrumental balance I thought quite good, and an inaudible surface helps greatly in building an over-all effect of realism.

I doubt whether there are any other recordings of this music, and if it interests you it should be a safe buy.

The Stravinsky is quite intriguing, even on a first hearing, and will probably improve with acquaintance.

TCHAIKOWSKY—Romeo and Juliet Overture-Fantasy, Overture 1812 Opus 49, Marche Slav Opus 31. Played by the London Symphony Orchestra conducted by Hermann Scherchen. Nixa NLP909.

This is a high pressure record with a vengeance. It is quite outstanding for its weight, and for the realism of its reproduction.

These have been gained by a close microphone technique aided by an extremely wide frequency and dynamic range. By this means everything in the orchestra is heard the tympani (not forgetting the snare-drums which are used freely with startling clarity particularly in the score) and the brass.

In this I am reminded of those two magnificent earlier releases by Nixa of Belshazzar's Feast and the Planets.

As the jacket notes point out, many consider Tchaikowsky at his best in this kind of fantasy or tone-poem, or whatever you like to call it. It is certainly an awful lot of popular Tchaikowsky on one disc.

The performances are typically Scherchen. He is a remarkable musician—extremely competent both as an anatomist and a surgeon. Particularly in Romeo and Juliet, we hear him taking the music carefully apart, blending his colors with the care of a man painting a house, and finally producing from the clash and tumult a cataclysm of revitalised sound.

The close microphone I thought a little bit overdone. The display of instrumental tone it produces is often a joy to hear, but our aural presence is so immediate that many instruments appear to be playing private solos instead of building and sustaining a blended tone.

In the loud passages—what an understatement! — I sometimes flinched as one might do in the vicinity of a powerful locomotive in the process of taking off.

This is a record of unusual musi- al and technical interest and quality. ccasional surface noise — com- letely swamped most of the time— s my only real criticism.

BEETHOVEN—Concerto in D major Opus 61 played by Yehudi Menuhin and the Philharmonia Orchestra conducted by Wilhelm Furtwangler, HMV OALP1100.

Having listened to this recording everal times, and while appreciating the full its many virtues, I would ot accord to it the unrestricted raise it has received from many re- iewers. To give reasons isn't alto- ether an easy job, and I realise that any will not react as I did.

I have always seen this concerto s a supreme test for a master iolinist. It is not a tragic work, but requires great sensitivity and re- traint on the part of the soloist. Menuhin has both these, as well s a lyric quality that has been with him since boyhood, and which he has never shown so eloquently since his monumental recording of the Elgar concerto, unfortunately well back into the 78 days.

YEHUDI MENUHIN

But Beethoven also demands a strength and vitality which Menuhin never quite realises.

The last movement, for instance—how tame it can sound unless the violinist is able to bite into those opening notes, and to pursue them to the end with the vigorous joy which surely Beethoven wrote into them.

But, as is so often the case elsewhere, Menuhin's reading doesn't see it that way. His performance, fine and beautiful although it is, is therefore not so good that it can be considered the last word.

But at the moment, there may not be a better one. It certainly far surpasses the efforts of the early LP era, and if you like the purely lyric approach it may be your first choice.

SAFE RECORDING

The recording is safe, sure and solid. It balances excellently with the violin, it has just about the right amount of reverberation and aloofness and there is a relaxed air about it which is the test of a good team.

As so often happens with Menuhin, the violin tone is rather thin in the upper register, even with the microphone close enough to hear his left hand stopping the strings, but it is always clear and sweet. In the lower strings it sounds exceptionally rich and beautiful.

Altogether this is a record to be reckoned with. In any company it will remain distinguished for many a day.

BRAHMS — Alto Rhapsody with Male Chorus and Orchestra Opus 53; Four Songs. Kathleen Ferrier with the London Philharmonic Orchestra conducted by Clemens Krauss, piano accompaniments by Phyllis Spurr. Decca LXTA-2850.

This is the best record of Kathleen Ferrier I have ever heard, and you do not know the full extent of her musicianship if you have missed it.

The Alto Rhapsody is the outstanding side. The music might have been written specifically for her.

The recording of this piece which has always stood out in my mind is the old 78 Marion Anderson, but even with the advantages of modern recording, I doubt whether she would have made a better job of it.

Hers was a voice we admired, but which often did not fully reach us. Kathleen Ferrier has an indescribable intimacy and sincerity which establishes instant contact. It is quite impossible to hear it without being aware of this personal appeal.

Nowhere is its beautiful control and complete consistency more evident than in the Rhapsody. It is hard to imagine it ever being better sung.

Both sides are recorded much more cleanly than other Ferrier discs. The EMI setting will be best for wide range gear, otherwise you may be aware of a slight distortion on louder passages. Musically it is excellent—the recording is good, orchestra and accompanying voices just right.

Not to be missed on any account.

RICHARD STRAUSS — Don Juan, Till Eulenspiegel. Played by the Vienna Philharmonic Orchestra conducted by Wilhelm Furtwangler. HMV OALP1208.

Without doubt Don Juan is the star of this record, even if he isn't as impetuous a character as usual.

Furtwangler builds him into a much more imperious fellow—magnificent rather than hot-blooded. But how magnificent he is!

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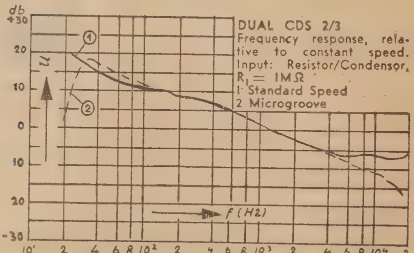

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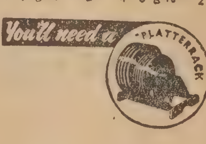

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wider-range atmosphere than the usual run of HMV's, as instanced by the impressive opening bars in which only the staccato horns I thought were lacking in full significance.

I can't be as equally enthusiastic over Till Eulenspiegel. Here the recording doesn't achieve the brilliance which this sparkling little work demands, nor indeed does it seem to sparkle as much as it might. Fundamentally I think the recording is OK but it appears to have lost its bloom in the processing.

Furtwangler leaves his mark on everything he does, and one's reaction is therefore tempered by individual reception of his ideas. I like a more romantic Don Juan, and a less profound Till, but perhaps you don't. Irrespective of opinions, the impact of the Don Juan side gets high marks from me.

TCHAIKOWSKY—Symphony No. 4 in F minor Opus 36. Symphony No. 5 in E minor Opus 64. Played by the Philharmonia Orchestra conducted by von Karajan. Columbia 330CX1139 and 330CX1133.

Columbia's combination of von Karajan and the Philharmonia Orchestra is almost axiomatic with high-grade recordings.

Apparently studio conditions have been worked out which are duplicated for a whole series of recordings, or so it would seem from listening to them.

The best general comment I can make about these discs is that they are just as good as previous releases in the series.

In both will be noted the excellent balance of everything that makes a good record—microphone placement just right to catch the entire orchestra with good presence, but without "hugging" or descending too deeply into the depths. Reverberation is nicely controlled so that the orchestra never "washes out" in lightly orchestrated passages, or becomes muddy under pressure.

The sound on both discs is rich and full, articulation always clear.

NEAR THE LIMIT

There is very great dynamic range and high amplitude cutting on loud passages. To be super critical I fancy there is some slight deterioration under these conditions indicating that things have reached the upper limit for safety with wide range gear.

My moving coil pick-up is on the ice at the moment, and it could possibly be a less than perfect stylus, but I don't think so. It's rather that records as good as these deserve to be picked over with a high-powered glass.

The performances are a model of reliability, even if the playing hasn't got quite the lash of Cantelli or the super-shaping of Furtwangler. As an all-round recommendation I think I'd put them at the top. In the case of the 4th, competition from Franz Andre, Kubelik and Scherchen has been overcome to earn this place—no mean feat.

If anything the hand is a bit on the heavy side. Both the third movements show this, but they are well within an acceptable plus or minus.

There is some swish on the second side of the 4th, and too many crackles near the beginning of the 5th. Surface noise, although swamp-by the music, is audible. Other-ise, technically, they are very very od.

To sum up—just what many :haikowsky fans have been waitg for.

HERBERT VON KARAJAN

DEBUSSY—La Mer. RAVEL —Rhapsodie Espagnole. Played by the Philharmonia Orchestra conducted by Herbert von Karajan. Columbia 330CX1099.

Another splendid disc from the arajan-Philharmonia combination, ıst to show that it can handle ebussy and Ravel as well as 'chaikowsky. Once again I have to ame this as the best recording I now of these two.

As a demonstration of the Philharıonia balance, I commend the openng sections of the Ravel.

There is, for instance, a wood-wind assage in which you will be able to ear how effective is the degree of everberation, particularly in chieving an impression of depth vithout loss of clarity or presence.

GOOD BALANCE

Later is heard the bass end, the xtreme top represented by triangles nd such, and then the full orchestra, ts clarity unimpaired by the extra veight. Someone has taken much rouble and exercised much knowow to make recordings as good as hese.

A quiet surface is most welcome. Characteristically the frequency ange isn't fully effective, but as I ave remarked before, the balance s so good that this is hardly riticism.

Very often to achieve the one we nust modify the other

BORODIN—Polovtsian Dances, In the Steppes of Central Asia. IPPOLITOV IVANOV — Caucasian Sketches. Played by the Philharmonic Symphony Orchestra of New York, conducted by Dmitri Mitropoulos. Philips HO2107L.

Eminently successful — probably he best recordings of this music in he catalogue. The sound is really irst class. It is as clean and clear as bell, whether in a full, wild climax s in the Polovtsian Dances, or the cor anglais solo in the "Steppes".

I particularly liked the overall balance. It is obvious that recording engineers are beginning to get real results in the matter of reverberation and mike placing. The Sketches are a very good example of this — notice how the numerous solo sections for all kinds of instruments measure their proportions against the full weight of the orchestra when it comes along. And with it all, no signs of distress or distortion on the widest range gear.

Frequency and dynamic range are considerable, but again well balanced. No edgy highs here.

The sound is as rich as the music, and the playing of the highest class. I'd have liked a bit more speed in the Dances, although their rhythm is there.

Borodin can't take all the credit for his contribution, of course. Most of the orchestration was done by equally famous Rimsky Korsakov. Incidently there are no voices in the Dances.

For a real thrill, turn up the gain on the last of the Sketches.

I found the EMI setting the best, although the AES is somewhat brighter.

Surface noise is low—up to the usual Philips standard.

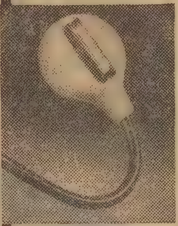
VAUGHAN WILLIAMS—Sinfonia Antartica. By the Halle Orchestra, conducted by Sir John Barbirolli for HMV OALP1102. By the London Philharmonic Orchestra and Choir, conducted by Sir Adrian Boult for Decca LXTA2912.

This symphony is based on music written for the film Scott of the Antarctic. It is programmatic in the extreme.

Each movement is preceded by an appropriate quotation taken from various sources, and which, in the Decca jacket notes, do not agree with the accepted text in more than one instance.

As a musical essay on frozen wastes it is extremely vivid, even to the wind machine, whose eerie contribution emphasises the desolation of the musical scene, and which doesn't sound as incongruous as might be expected.

In addition to the musical effects, there is the theme of man's losing struggle against the wild elements, which finally triumph, leaving the cold, desolation, and the wind machine in full possession. The wailing voices of soprano and choir, an interlude for the organ, and even for the penguins, are all worked in.



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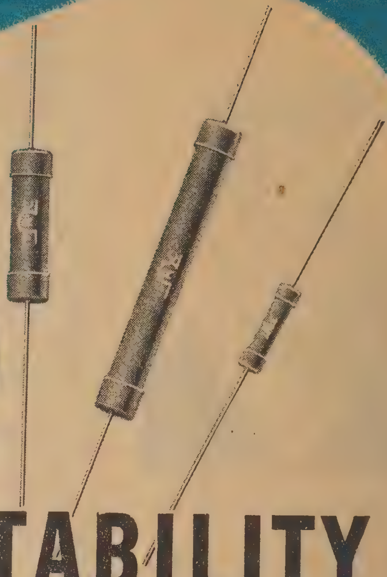

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DCH	2-watt	300 ohms to 5.1 megs.	2-1/16"	19/64"	750

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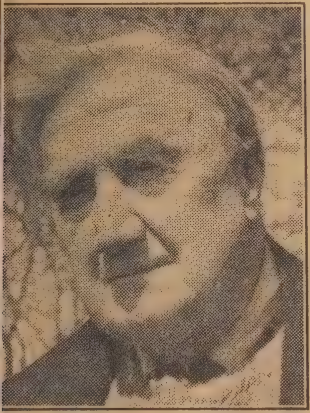
There is an undeniable impression glorified film music, absorbingly teresting to the student of orches- al effects, but rather bleak and petititve to others. According to ur point of view, you may con- der it the best or the weakest of aughan Williams. Listening to two rsions of it may not be the kind- t introduction for a reviewer, for missed the live performance in ydney.

Of the two records, Decca's is so perior technically that it leaves argent's very good effort well be- nd. It is in fact recording of the ghest class, much the more forward the two, and equal if not superior performance.



VAUGHAN WILLIAMS

Sargent's disc, made about a year rlier, does succeed in creating a reater impression of space than oult's, but in almost every other spect it is inferior. I suggest a arm fire as an antidote, for it ill leave you physically and mentally in a shiver.

POKEN WORD

The Decca record includes quota- ons spoken by John Gielgud—well nough done, but you may think em something of an intrusion. It lso has a very sudden and irritating reak in the long Landscape move- ent, which Sargent avoids. Mar- aret Ritchie is the soprano in both ecords, which is a good thing, for he does her part superlatitvely.

It's a pity that these two records hould hit the market at the same me, for Sargent's version is too ood to be overshadowed.

Both records showed some sur- ace blemishes which, although not agic, do detract from the standard e expect today.

OPERATIC ARIAS — Celeste Aida; Nume, Custode E Vindice from Aida; Depuis le Jour from Louise; The Flower Songs from Carmen. Played by Camarata and his orchestra. Festival-Decca CFR10-712.

Attractive arrangements of some ell known operatic arias which nd themselves well to Camarata's kilful hand. Here is a band which, ainly through studio acoustics, is ade to appear even larger than it . It has a full, rich sound about it, the outlines are clear, and the balance effective.

I liked best the Flower song and Charpentier's beautiful excerpt from Louise in which, however, more effective use could have been made of the violin solo.

Not a record for purists, but just the thing for those who like the music whether played or sung.

The recording is good throughout and surface noise low. An EMI curve tames a slight edge in the top register.

TCHAIKOWSKY — Symphony No. 6 in B minor, "Pathetique", played by the L'Orchestre de la Societe des Concerts de Paris, conducted by Erich Kleiber. Decca LXTA2888.

This is a record which fails to hit the mark as fully as it should.

There is much in it which is good, and much which is equally disappointing.

It is a hard driven performance. Kleiber has disciplined his players to a pitch where the heart of the music has taken second place to sheer intensity. None of Tchaikowsky's symphonies has much emotional restraint, particularly the Pathetique, and if you take this away there isn't too much left.

Maybe I'm over-stating the case, but reference to some earlier releases, and in particular the old 78 set by Furtwangler which every reviewer feels impelled to mention, will show how the players can be driven—audibly so in that terrific third side — at the same time achieving that undeniable pull at the heart-strings which Tchaikowsky achieved in this, the best of his symphonies.

REMOTE

The recording is a remote one—almost half-a-hall away at times—and this has prevented the full force of the orchestral weight being reached as, for instance, the Philharmonia do it.

This technique gives a fairly even distribution of instrumental balance, but it requires high volume to do it justice, and a big room.

Played this way, and accepting the conductor's approach, there is plenty of impressive sound.

CHABRIER—Marche Joyeuse, Habenera, Espanier Rapsodie. BERLIOZ: Rakoczy March, Will-o'-the-Wisps, Dance of the Sylphs from Damnation of Faust. Festival CFRI0-714.

Extremely forward recording, favoring the middle and top register, gives considerable impact to this disc. An NAB setting with an extra notch of bass gave me the best balance, which at times was very good. American Decca seem to specialise in this type of recording, preferring sharply etched outlines to the more spacious effects of European technique.

The selections blend well, in that if you like the Berlioz you will probably enjoy the Chabrier, and vice-versa. They have all proved themselves good concert pullers.

Most of the music is brilliant, and the performance has been geared for the same result. All the jingles and cymbals are unmistakably there, but this close type of recording tends to become a little oppressive at high volume.

Surface noise shows up as a faint rustle on the softer passages.

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SHORT-WAVE NOTES BY ART CUSHEN

HOW TO PREPARE S.W. REPORTS

The value of your report to a shortwave station is discussed this month and an endeavour made to give readers help many have requested.

MANY readers have at times in the past asked for details as to the type of information we supply to radio stations in order to have our reception verified, and it is at the latest request, that of Mr. G. D. Hatfield, of Jedwood, NSW, that this article is written.

We should remember two main points about our report that should never be overlooked. There should be enough program information to let the station verify with assurance, and technical information about the signal. Include notes on strength, interference, comparison with nearby transmitters, and suitability of frequency and the transmission times for reception in this area, if the broadcast is intended as such.

PROGRAM DETAILS

The material which the listener hears should not be sketchy and should be of sufficiently localised nature to be confirmed. By this we mean that, when a program is being played and is a transcription, the exact content of this recording is not important. What is of benefit is the exact announcement given after the program from the studio.

If you were listening to Take It From Here from VLT6, the mention only of the title of this program is sufficient. The content may not be recognised by the station, as the disc will probably have been forwarded to another station before you report is received.

Better to concentrate on actual station breaks, such as time and weather information.

In the case of VOA transmitters which suffer from jamming, the extent of this should be noted. Although the foreign languages may prove difficult, some idea as to the language used before and after the station break (which is given in English each half-hour) should be given.

VOA generally announce on the hour and half-hour. One exception is the Russian broadcasts 12.15-12.45 am and 1.15-1.45 pm during which there is no identification.

TIME ZONES

The knowledge of the time zones helps to identify a signal when a clock is heard and most stations have their own musical identification signal. Do not forget to give the date and the time. When in doubt quote GMT.

It is wise to give the day and month of reception. Spell these out, to avoid confusion. Remember that, when writing the date in figures, some people put the month first, so your report could be taken as the month and then day, instead of the day and month as you intended.

The frequency in kilocycles should be given, and in the case of European stations, it is also advisable to quote the wavelength in metres, the system more in vogue in that part of the world. When megacycles are given, the conversion of this is simple, as 1000 kilocycles equal one megacycle, so that a station on 6130 kilocycles is operating on 6.13 megacycles.

The technical details in your report should cover comparison of signals, weather information, frequency suitability, interference, suitability of hours of transmission, and many other items which will come with experience and a fuller knowledge of the individual station requirements.

The gauging of signal strength for many years has been the R code which rates signals from zero to nine with an extremely strong signal at R9.

For some years the BBC has been using a 0-5 code covering signal strength, interference, noise and overall merit. From this has grown the SIMPO code, and this is used by many broadcasting and DX organisations. Radio Japan, Radio Canada use this on their graphs, and the SIMPO code is under consderation by the NZ Radio DX League.

SIMPO stands for five groups of figures which are made up of Signal, Interference, Noise, Propagation, and Overall Merit.

The recognised list is given below.

FADING

Fading of the signal should not be overlooked. The CBC rate this on a 1-to-5 scale as follows:—

1, Deep rapid. 2, Shallow rapid. 3, Deep slow. 4, Shallow slow, and 5, Negligible. A note on any selective, fading with distortion, should also be made.

It is a courtsey to enclose return postage in the form of a Commonwealth Reply Coupon for Commonwealth countries, and an International Reply Coupon for foreign countries. These coupons are obtainable at the post office, and are exchanged by the station for return postage to put on your verification.

Many of the large Government-controlled stations do not require postage, but the listener will be able to decide. We find that the smaller private-owned stations do appreciae a help with postage.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are Eastern Australian.

RADIO TARAWA

RADIO TARAWA (Gilbert and Ellice Island Colony) has a small building housing the equipment for Radio Tarawa's two outlets, and for use as a studio. It was established on Betio Islet, Tarawa, the main business and administrative centre, reports Jim Shortall, Sydney.

The equipment was formerly in the home of one of the radio technicians, Mr. L. Znidersic.

The stiuation is now as follows: VTW on 844 Kc broadcast band, with a radiated power of 30 watts, provides programs intended for the Tarawa atoll.

VTW is on for one one only, Friday, 5.30-6.30 pm. The power of this station will soon be increased to 60 watts. VSZ10 on 6050 Kc provides programs for the more distant parts of the colony, with a power output of 500 watts, using a transmitter normally employed for Morse transmission.

SIGNAL	INTERFERENCE	NOISE	PROPAGATION	OVERALL RATING
1. Barely Audible	1. Very severe	1. Very high	1. Extreme	1. Poor
2. Poor	2. Heavy	2. High	2. Severe	2. Fair
3. Fair	3. Moderate	3. Moderate	3. Moderate	3. Good
4. Good	4. Just audible	4. Low	4. Slight	4. Very good
5. Excellent	5. Nil	5. Very low	5. Nil	5. Excellent

THE BBC USING 11 METRES

The use of the 13 and 11 metre bands by the BBC for overseas broadcasts has been brought about by the sunspot activity which has shown a fairly rapid increase these last 2 or 3 months.

THEY are now developing the tendency to operate on actual maximum usable frequencies on the individual circuits at the first available opportunity.

The idea of this is to get as high as possible as soon as possible in order to avoid jamming and other interference in the 19 and 25, and, to a lesser extent the 16-metre bands.

To 13-metre transmitters have recently been added, firstly a new frequency 21660 Kc for the Middle East and East Africa between 8.30 pm-1.45 am, and secondly, 21740 Kc for West Africa, 7.30 pm to midnight. GSH (21470) has been running for some time, and GRZ on 21640 beamed to Australia from 7.30 pm.

Four frequencies now used in the 13-metre band will be joined on October 2 with the 11-metre frequency, introduced for Africa after a lapse of operating on the band for nearly four years.

This 11-metre transmitter will be of an experimental nature in order to get some idea as to whether 11 metres is likely to propagate during our summer months.

In this area, our Pacific service will be retimed on October 2 to 6.00-6.45 pm when they expect to use GWC (15070), MCT (11960) for New Zealand on long path, and GRV (12040), long path, GRZ (21640) will carry an exploratory short path transmission for Australia.

Flashes from Everywhere

FIJI'S VRH4 on 3980 Kc is now using a new incidence vertical antenna which is expected to give better local reception. A news broadcast in English has been added with information of a local nature and is aired Monday, Wednesday, Friday, 7.10 pm, and repeated the following day at 11.25 am.

The New Zealand Broadcasting Service provides news for a weekly news session for New Zealanders in the island's broadcast Sunday, 10.45-11.00 am, while a similar session from the ABC is released on the same day at 3.45-4.00 pm.

TAIWAN'S Home Service, which operates on many frequencies off the normal bands, is listed in a recent issue of World Radio Handbook bulletin. The frequencies are 4770, 5010, 7198, 9525, 11810, 15105 Kc, which broadcast to the Chinese mainland, 6.55-10.00 am, 12.55-3.00 pm, 6.53- pm-3.00 am. All transmitters are in chain, the complete transmissions being in Chinese.

TANGIER'S new IBRA Radio Mission, which has a Swedish mailing address of Box 822, Stockholm, inaugurated transmissions recently, with two 10,000-watt transmitters on 9995, 11700, 15025, or 15253 Kc.

PHILIPPINE'S Manila transmitters, of the Philippine Broadcasting Corporation, have the new address of Radio Centre, Philippines, Taft Av., Cor. San Luis, Manila. The transmitters are DZPI, DZRH and DZMB, with the short-wave relays of DZH3 (9500) 1000w (relays DZPI, DZH2, 9640), 1000w, DZH4 (6000), 1000w (relays DZRH) and DZI7 (6080), 300w (relays DZMB). DZI7, which is seldom heard in this area, uses only 300 watts on 6080 Kc, and transmits 6.58 am-2.00 am next day. **BRAZIL'S** Radio Maua, Rio de Janeiro, has these calls assigned—ZYX24 (9705) and ZYX25.

THE HAM BANDS WITH BILL MOORE

The setting up of an amateur radio station at such an important centre as the Science Museum London, is a forward step in publicising the movement. The best way this can be done is by means of a well organised exhibition of amateur radio.

N excellent move in keeping amateur radio in the public view is the de- sion to establish an amateur radio ation at the famous Science Museum, uth Kensington, London.

The move was arranged after discus- ons between officials of the Science useum and representatives of the Radio ociety of Great Britain.

The station will be set up in the demon- ration room adjacent to the Communica- ns Gallery and will be operated each y by members of the museum staff who old amateur licences. It is hoped the ation will become a focal point for siting amateurs.

The task of designing the station and sociated aerial systems will be under- ken by a small panel of members of e RSGB's technical committee.

G5CS, deputy keeper in charge of the ommunications department, who has een largely responsible for the initial egotiations, will be in charge of the ation, but G3JUL ex Y12AM will look fter the operating.

It is intended that the station will be model of first-class design and operation nd that, QRM permitting, it will estab- sh a world-wide reputation for efficient peration.

The main purpose of the station will e to demonstrate the technique and ractical operation of a radio communi- ations station and by showing some f the interest and fascination of DX orking to a wider public, especially o schoolboys and students, to encour- ge some to consider the attractions of career in some branch of the radio ndustry.

More Z calls

THESE days the new Z calls are more than balancing out the cancellation f station licences. For a period in he past few years the new stations com- ng on the air were barely covering the ancellations and the total amateur opulation was static.

A healthy increase is now being re- orded each month with the limited AOCP stations licences. The rate of in- rease of course is not comparable with he years immediately following the last war.

Russian amateurs

AMATEURS generally are wondering whether the improved international relationship between East and West will affect the operation of the many Russian radio amateurs who for some five years have not been permitted to contact stations outside the "Curtain".

If the UA, UP, UQ's, &c., appear the WAZ award will be in business again. The Worked All Zones DX Award issued by the editors of CQ was one of the most difficult to obtain.

It was necessary to contact 40 zones into which the world was divided and produce the required 40 confirming QSL cards to qualify. Zone 23 would still, however, be a problem as it covers Tibet and portion of China.

Communist China would also have to ease restrictions to allow the whole 40 zones to be contacted.

Since writing the above it would definitely appear that the restrictions covering amateur radio in the USSR have been eased.

Plenty of UA, UB, UQ, &c., stations were heard working stations throughout the world and were calling CQ as of yore. It appears that stations in Siberia (UAO and UA9) are still restricted as they were calling WSEM, not the normal CQ as were the other USSR stations.

Notes from WA

Notes on West Australian VHF doings were again contributed by Wally Howse, VK6ZAA.

At the last meeting of the VHF group Don Graham, VK6HK, lectured on the development of mobile gear and operation on the VHF bands. Passed around for inspection were Tom Reed, VK6TR's mobile transmitter and Xtal converto. for 50 Mc/s and Don's 144 Mc/s mobile receiver.

Don offered many interesting suggestions on this type of operation. Frank Chapman, VK6CC, also displayed his 50 Mc halo antenna. The thanks of the group were extended to Frank and XYL who acted as hosts for the evening.

VK6BO has made further checks with VK6WG in Albany on 144 Mc/s without success. The latter plans to drive a QQEO6/40 with his 522 and when this job is completed the possibility of contacts over the 240 mile path will be vastly improved.

VK6ZAG has appeared on 144 with an 832 final. VK6ZAR uses a QQCO4/15 tripler to the band, four elements and a much modified AR301 receiver. VK6ZAC is busy building his receiver.

On 288 Mc/s a third Xtal transmitter has appeared—that of VK6ZAV's 832A tripler. VK6FB recently arrived on the band. VK6BO has built a 6J6 neutralised P.P. triode RF amplifier for the band and is pleased with the results.

VK6HK has revamped his Xtal convertor and may rebuild his transmitter.

Stan VK6ZAS has been asked by the group to determine the VHF records made by West Australian amateurs. Anyone with claims on the subject should contact Stan. It is hoped to publicise these records so that those new to the VHF bands can strive to improve on them.

VHF in NSW

THE NSW VHF section devoted their first field day in September to a series of tests on the 144 Mc/s band using slave antennas. The results were promising, although many outside factors appeared to affect the results. The experience gained will be invaluable in the carrying out of additional checks in the future.

Three sets of stations were in the field plus the control and check station located at Dural, an elevated point out of Sydney. The latter was operated by John Miller, VK2ANF, assisted by Roy Hart, VK2HO, and E. Griffiths.

The other three groups were located in the Blue Mountains west of Sydney.

Keith Alcock, VK2AOA, on Mt. York, endeavored to reflect back to city signals from Harry Lapthorne, VK2HL, in the Hartley Valley. Ray Biddle, VK2DB, and Bob Ridgley, VK2ZAR, on the edge of the mountains also tested with reflected signals from Bert Clarke, VK2IC, who was located on the plains.

Cliff Lamb, VK2LG, and John and Cec Thornthwaite, VK2ATO and VK2AZO respectively, tried to reflect back to Sydney signals from stations in the Hunter Valley in and west of Newcastle.

Many other amateurs assisted the above stations in the test.

The section will conduct a 56 Mc/s band warming contest on November 1 when the band officially opens. Cross band contacts to 50 Mc/s will be allowed and a varied point scoring system has been arranged.

It is anticipated that shortly the section will co-operate with the Spelaeological Society (they carry out the scientific study of caves) on tests using VHF gear in the caves for communication.

The present system using telephones is not flexible and it is thought radio would greatly assist in cave exploration.

DX of the month

FOURTEEN Mc/s provided interesting DX in August, although the early afternoon peaks of June and July were not repeated. Early in the month the period 1600 to 1700 hours EAST saw the band open to ZD's and ZS's but they did not last long. Morning openings were similar to those of the previous month.

Early in September the DX gang appreciated the conditions that are to come when between 1600 and 1800 hours the Europeans and North Africans were peaking to S7.

Later in the evenings the band again opened to Europe. From 2100 hours all continents except South America appeared and the band was still in good shape until after midnight. Some excellent DX was evident including ZD6BX, 3A2AG, &c.

It appears that FW8AB on Wallis Island may be contacted around 0800 hours Sunday mornings. Bari, VR2BZ, contacts him on schedule at that time—frequency 14040 Kc/s.

FW8AB has been a problem to many of the DX gang as the W6's seem to have a monopoly on him. At that hour the W stations should not be so strong at his QTH and other amateurs should have a better chance of contacting him.

Russ, VE6VK, is always anxious to contact VK stations as he hails from Auburn, near Sydney, and moved to Calgary after acquiring a Canadian YF. Russ was a telegraphist with the PMG's Department in many Australian towns.

Running 300 watts to three elements he provides an excellent signal, and is generally active around 1400 hours.

VQ8CB operates daily from Chagos Archipelago at 1030 hours GMT. Active on 14100 he has a distinctive signal—T8, chirpy and modulated. He is restricted in his operating periods due to battery drain and sometimes has to close quickly.

RSGB president, Herb Bartlett, G5QA, is active on 14 Mc/s and with the improved conditions is anxious to contact his many Australian friends of the previous sunspot maximum.

Call sign number plates

THE use of motor vehicle number plates covering call signs is now adopted by the majority of States throughout the USA. Recently four more States—Utah, Maryland, Connecticut and Illinois—passed legislation permitting the use of distinctive number plates for amateurs.

Currently 32 of the 48 States in the US offer the privilege, as do the territories of Alaska, Hawaii and Canal Zone. The nearest seen in these parts was the effort of VK2OS who managed to obtain VK205 for his motor number plate.

Interference

TWO sets of regulations recently placed before the British Parliament are designed to control radio interference from refrigerator and small motors in industrial or domestic appliances.

Effective from September these sections of the Wireless Telegraphy Act provide that all new refrigerator motors be suppressed and that all appliance motors old or new be similarly treated.

The subject of motor design to afford space for the fitting of suppressors is being taken up with the manufacturers.

On the subject of interference stickers are now available from the Radio Society of Great Britain for attaching to motor vehicles stating that action has been taken to suppress any engine made QRM likely to affect BC and TVI receivers.

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Width 11in.
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- **DRAWING SETS:** Brand new. Superior quality. Three types 27/6, 32/6, 50/-.
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- **AIRCRAFT BONDING TESTER:** .001 Ohms to .05 Ohms. Brand new in box complete with leads £10
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AT5 TRANSMITTERS

Frequency 140 Kcs to 20 Megs. Containing:— 3 — 807; 3 — 6V6 Valves, transmitting condenser and many other useful components.

Price £4/19/6 Syd. Price only.

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Suitable for Fishing Boats, Small Shipping, or Communication for Bush Fire Brigades. 12-volt operation. Frequency 4.2 to 7.5 Mcs. Complete with valves, two power packs, leads, microphones and headphones. In good condition.

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Transceiver RT34/APS13

Frequency modulated. Approx. 450 Mcs. Valve line-up: 9—6AG5; 2—2021; 5—6J6; 1—VR.105; also contains Genemotor. Input 27-volt, 1.5 amp; Output 285-volt, 60 M/a.

PRICE £10

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The foremost High Frequency Communications Receiver made in Australia by S.T.C.

Frequency coverage: 1.5 to 24 Mcs. 240 volt AC operation. Nine Valves. Crystal Filter. Specially designed to withstand exposure to high temperatures and humidity. Sensitivity better than 2 microvolts.

Dimensions: Height 11½in., width 2in., depth 12in., weight 74lb.

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BEACON RECEIVERS

Small sized lightweight 5-valve Aircraft Receiver. Frequency coverage: 195 Kcs. to 420 Kcs. I.F. Frequency: 135 Kcs Sensitivity: 3 microvolts for 10 MW output. Power output: 230 MW. Current: 9 amps 24 volts. Can be converted to car radio. Dimensions: Height 4in., width 4in., length 6 3/8 in., weight 4lb.

PRICE: £5/17/6
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FEDERAL QSL OFFICER

RESIDENTS, secretaries and other officials of amateur radio societies me and go, but WIA QSL officers never em to change Perhaps the position is t as arduous as serving on the ecutive. The tempo may be slower—ssibly it is more interesting respective of the reasons, most QSL ficers throughout Australia have held fice for many years and so performed valuable service for their fellow mateurs.

A case in point is Ray Jones, VK3RJ, ederal WIA QSL officer for the 22 ears, despite the meanderings of the ederal executive over the years. Ray rior to his appointment to that position was QSL officer for the Victorian division nd did not relinquish this post until orld War II.

He has handled 624,179 QSL cards to ate. This, at the accepted rate for overl handling of 100 cards per hour, represents 260 days of continuous work.

If you continue the mathematical nalysis it will be found that Ray has pent about an hour a day for 25 years orting and dispatching cards for his ellow amateurs.

Ray Jones VK3RJ

Ray was born in 1901 and since 1914 has been with the PMG's Department except for periods in both world wars In World War I he served with the AIF Wireless Unit and in World War II with communication units in the RAAF. His whole life has been spent with communication organisations.

He started in radio in Maryborough Victoria, in 1914, and with other youths experimented with spark transmitters and crystal receivers. From 1922 to 1925 he listened to many of the early amateur experimental stations including 3BU, 3BY, 3SW, &s., using crystal and later bright emitter valve receivers.

In 1926 Ray built his first short wave receiver, a two valve Reinartz detector and one audio. In 1928 the AOCP was obtained and VK3RJ came on the air around 7 Mc/s with 3 watts input to a 201A.

For many years now bi-weekly schedules have been held with W2CC contacts totalling several hundred, and weekly QSO's are made with FK8AC.

Emergency work

On a number of occasions VK3RJ has been operated during emergencies with traffic to Tasmania. During the Tasmanian floods of 1929 he handled 25,000 words of traffic with the late Trevor Watkins, VK7DX.

In WIA affairs Ray has always played a prominent part. QSL officer for the VK3 division from 1931, president of the key section of the VK3 division in 1932 and from 1934 to date Federal QSL officer. Since 1932 Ray has contributed a monthly article to "Amateur Radio" on QSL Bureau matters.

In 1954 his work on behalf of the WIA and amateurs generally was officially recognised when he was appointed an honorary life member of the Victorian division of the WIA.

Ray's efforts on behalf of his fellow amateurs take hours, but in his spare time collects stamps and prospects for gold.

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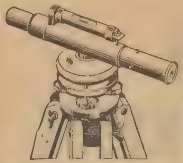

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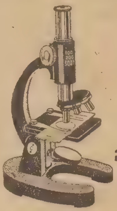

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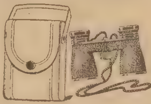

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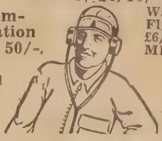
R.A.F. LEATHER FLYING HELMETS, 50/- each. SUITS, £6/10/-.



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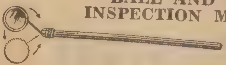

8/9

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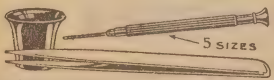

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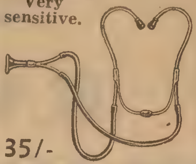

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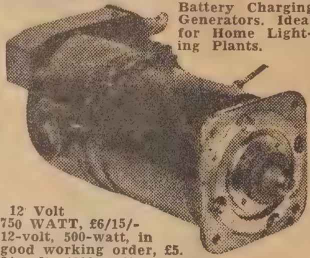

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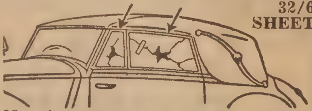

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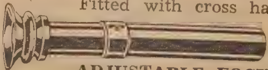

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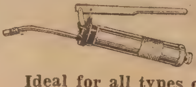

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12-volt, 25/-
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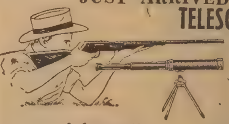

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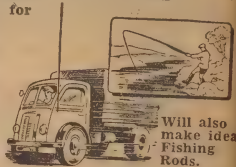

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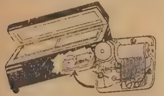

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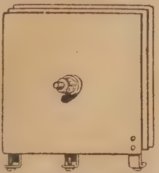

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Transformers to suit above Rectifiers. 2 amps, 39/6; 6 volt, 5 amps, 45/-; 12 volt, 5 amps, 55/-.

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Will work off any Lighting Plant.

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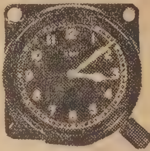
As used by the R.A.F.



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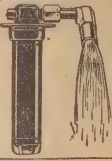

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COMPLETE WITH TEST PRODS

£5/17/6

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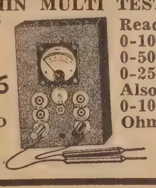

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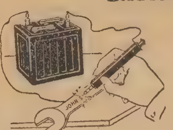

29/6

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A Simple Set For Beginners

From Page 71

wood. The hole is then filled with plastic wood, sanded when hard, and will be invisible when painted.

Because of the compact nature of the set and case, the fitting of the one into the other calls for a little juggling. First unscrew and remove the nut holding the reaction capacitor in place. Then slip the chassis into the case sufficiently clear of the top to allow the leads from the coil to be connected to the tip jack sockets. Now ease the chassis toward the top and pass the tuning capacitor shaft through the hole in the front panel.

By twisting the chassis slightly sideways it should now be possible to pass the toggle switch through the hole in the top of the case.

Fit the countersunk mounting screw and then replace the reaction capacitor and fit the nut from the front of the case. The hole in the case is large enough to permit this.

The filament leads are connected to the contact brackets by means of solder lugs held under one of the mounting nuts. After the filament battery is slipped into place the HT battery may be fitted and the HT leads connected to it.

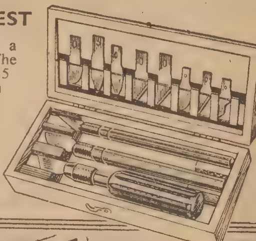
For a handle we used a length of one-inch wide plastic strap fastened to the side of the case with bifurcated rivets approximately ½in long. These must be flattened on the inside to avoid fouling the chassis as it is fitted and removed.

To hold the back closed we used a short length of the plastic strap and a press fastener. The latter may be purchased from upholstery suppliers. The strap is riveted to the back about an inch below the top and the fastener is arranged to occupy the approximate centre of the case top.

Finish will be according to your own taste, but a bright glossy lacquer will give your case a smart appearance. The large knobs make the controls easy to handle and one of the ridges may be colored to serve as a pointer. Station markings may vary from short panel pins driven into the panel to actual lettering, according to your skill.

No. 82 TOOL CHEST

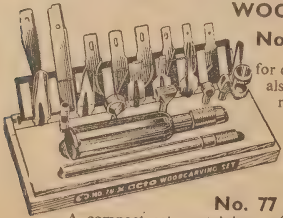
A comprehensive kit in a polished wooden cabinet. The three knives, Nos. 1, 2 and 5 are included and in addition a range of X-acto blades for cutting, carving, chiselling and many other intricate operations. No matter how difficult the task there's an X-acto blade for the job.



MORE skill at your fingertips! TRIX X-acto HOBBY KNIVES and TOOLS

WOOD CARVING SETS

No. 78 A really fine set with both the No. 1 and No. 5 knives for delicate or heavy work. The set also contains the gouges, punches, routers and a good choice of blades all fitted into a stout platform block.



No. 77

A compact set containing the heavy duty No. 5 knife, 6 gouges and a selection of blades. Mounted for easy access on a platform block.

NO. 77 X-acto WOODCARVING SET

The basis of the X-ACTO range is three tool handles on to which a variety of implements can be fitted. The keynote interchangeability so that a complete set of edge tools can be fitted into surprisingly little space.

ASK TO SEE THE NEW X-ACTO RAZOR SAW SET

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Variable Pitch Records

(Continued from Page 25)

necessary spacing control is obtained and this is explained by the accompanying diagram.

The original recording is shown as being made by the microphone and its associated record head, although the master is not necessarily cut at the time the recording is made. The tape passes two playback heads, number 1 extracting the prior information regarding recording level, whilst number 2 feeds the cutter.

Information derived from the lead screw monitor indicates the position of the groove already cut. The level at the cutting head is immediately available, but the same information is also stored on a "memory" drum, to determine the position of the following groove. Thus, at the computer, we have information regarding the general recording level to come, position and amplitude of the groove already cut, and of the groove being cut.

From all this, the computer calculates the optimum spacing and regulates the cutter position to within 1/10,000 of a millimetre.

Figure No. 2 shows the essential difference between a standard record, a Rhein record prior to 1951, and a Rhein record incorporating varying separation between grooves. In all three cases there are five unmodulated grooves on the left hand side.

Here's Your Answer Tom!

(Continued from Page 63)

might be implied by its inherent DC resistance.

This property of a coil of opposing any change in the magnetic field around it is called "inductance". It is a measurable quantity, and therefore has a unit of measurement called a henry.

A coil is said to have an inductance of one henry, if a change of current of 1 amp per second results in an induced voltage of one volt. In other words, if the current flowing through the coil increases from one amp to two amps within one second, and the voltage induced in it is one volt, you have a coil with an inductance of one henry.

However, such coils are only rarely required in radio work, except perhaps in power supplies, and the unit is far too large to be conveniently handled in many calculations. We must remember that the unit, henry, was introduced long before anybody thought of radio.

More usually, inductance values for radio work are quoted in millihenries, or even in microhenries. One millihenry equals 1-1000 of a henry and one microhenry is 1-1,000,000 of a henry.

The insertion of an iron core into the coil brings about an increase in inductance. This is because the magnetic field is much more intense in iron than it is in air. Therefore, the energy concentrated or "stored" in the magnetic field is greater.

OUDSPEAKER CROSS-OVER NETWORKS

(Continued from Page 87)

g will depend upon the particu-r type.

All components are attached to e baseboard with wood screws. ose through the coils must be ade of brass, or the "Q" factor the coil will be lowered. The ring is straightforward.

The output terminals of the net-ork are suitably labelled so that nnection of the speakers can read-y be made. Suitable letters for is could probably be obtained from e pages of a magazine or they uld be neatly printed by hand on e baseboard.

The variable output controls are ounted on two brackets made from 6-gauge aluminium and bent to ape in the vice. These hold the ntrols so that their spindles pro-ect through the top cover of the nit.

Much the same general construc-on could be adopted for any di-ider network, as the assembly is obust and accessible for wiring. A ooden cover of 3-ply was made o cover the unit, space being left n one end to enable the leads to e brought out.

ERFORMANCE CURVES

After the unit was completed, urves were taken with and with-ut the high frequency speaker net-ork connected. The results of these neasurements are shown in Figure . From this it will be seen that he network has only one true cross ver frequency and that the high requency speaker merely receives some of the energy that would otherwise be fed to the middle speaker.

These curves were taken, keeping the input voltage to the network at a constant value. In practice, the input to the network would be from the output of an amplifier and the shape of the curves will be somewhat modified. This is probably because the load of the network on the amplifier does change to a limited extent, with the result that the input to the filter is not entirely constant at all frequencies.

As a result, there is a tendency for the output from the high frequency section of the filter to rise above reference level at twice the cross over frequency of the network. We found that, with the coils that we used, and feeding the network from a typical ultra-linear amplifier, the rise did not exceed 0.5 db, which is a negligible amount.

GOODMANS CIRCUIT

The recommended circuit for the Goodmans range of speakers is shown in Figure 5, and all the information already given will be applicable to the construction of this network. The values of the components, being slightly different from the Wharfedale type, will result in a slightly lower crossover frequency.

In actual practice, the values of L and C suggested for the Wharfedale speaker system would probably be just as suitable for the Goodman types.

One other type of speaker system which we investigated was the twin speaker set as supplied locally by Jensen. The manufacturer's recommendations for this equipment are that the Tweeter (type 96PT) be fed in parallel with the low and middle frequency speaker (type 12PQ) through a 1 mfd series capacitor.

The cone characteristics and efficiencies of the two speakers are so designed that more complex divider networks are not needed and, in fact, not advised.

This set of speakers falls into the third class discussed earlier in this article, namely where the low and middle frequencies are handled by one speaker and the high frequencies by a separate tweeter.

If it is desired to convert the Jensen speakers to a three-speaker system one recommendation is as follows:—

The 15 ohm 12in speaker used as the low frequency speaker, two 3.5 ohm 9in x 6in eliptical speakers connected in series and correctly phased for the middle speakers, and the 25 ohm 6in tweeter for the high frequency speaker.

As the elliptical speakers are particularly efficient, it would be necessary to fit an output control to at least this section of the divider network to obtain balance of audio output.

With regard to the type of network used, i.e., quarter or half section, it is probable that the quarter section would be satisfactory. This is because there is no danger of overloading the lower speakers as in their normal applications they are used for the full range of bass and middle frequencies.

The 1 mfd high frequency feed capacitor, as mentioned previously for this speaker, would be retained with the three-speaker system.

We plan to have a closer look at the application of divider networks to these, and other locally-made speakers. This will include consideration of 2 ohm types which present particular difficulties in the design of networks because of the rather unwieldy component values, which are called for.

An article detailing our findings will probably appear in next month's issue.

★ ★ ★

Edison anticipates

A TELEGRAPH device, originally attributed to the American inventor Thomas Edison, was developed in Czechoslovakia 19 years earlier, according to Czech scientists.

A 100-year-old manuscript discovered in Prague among rubbish shortly after World War II proves their claim, the Czech scientists say.

The manuscript consists of one page of drawings and seven handwritten pages describing the diplex.

It is signed Dr. Vilem Gintl, a director of Austrian telegraphs during the time when Czechoslovakia was part of the Austro-Hungarian empire, and is dated July 14, 1855.

Edison's discovery was made in 1874.

A Czechoslovak university professor, Dr. Frantisek Rieger, who owns Gintl's manuscript, says that the Czech diplex is so like Edison's that parts are interchangeable.

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(for fluorescent lighting from car batteries)

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- Small size only 8" x 5" x 5".
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- Two ten watt fluorescents 12" long may also be used.
- Cold Cathode—instant start units also available.
- Correction condensors and ballast are internal.

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NOTE: Other units available for 40 watt—twin 20 watt—twin 10 watt—single 15 watt, etc.

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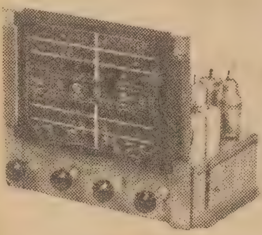
NEW RADIOGRAM - CHASSIS KIT - SETS

5 VALVE DUAL-WAVE



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These chassis when completed give excellent overseas, local and interstate reception as the coils supplied and intermediate transformers are high gain Permatune iron cored. Pick-up switch and volume control with A.C. switch supplied. Suitable for use with any crystal or high impedance magnetic pick-up.

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In case lots—6 reels (3 miles) NOW £4/0/0

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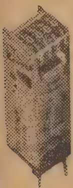

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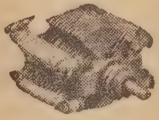

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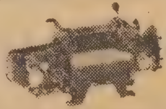

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Input filter supplied with genemotors

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Two U.H.F. Triodes Type 15 E

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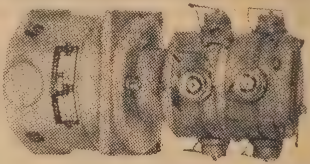

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Valves used 2.354, 1.1T4, 1.1S5, 1.1R5, postage extra.

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Address..............................

..............................*(State age .... if over 21 years.)*

25 XI.

ANSWERS TO CORRESPONDENTS

L.T. (Unanderra, NSW) writes to ex- s his appreciation of the Kloxette gn and to describe how it was built is 13-year-old son. Fitted with an l coil in place of the loop stick, it iving good performance in spite of oor location. He suggests an alter- ve method of alignment which does involve working through the bottom he cabinet and adds that the idea be worth passing on to other ers. He is looking forward to the ible publication of a five-valve ver- which would be more suitable for cult locations.

Very glad to hear that you have such good results from this set. T., and in particular that your son been able to complete it success- /. Such a joint effort—yourself mak- the cabinet and your son the set— t have given you both a lot of satis- ion and enjoyment. We appreciate r suggestion regarding the alignment edure, though we do not feel that original method is difficult. In fact, s adopted by many commercial sets varous forms. However, your sug- ion may be worth passing on and will keep the idea in mind. As say, the five-valve version should an interesting project and we may something about it in the future.

.R.A. (Yarravilli, Vic.) writes to tell that he is getting low frequency in- bility in the Wide Range Six receiver cribed in October, 1952, editon of the gazine. He is using a well-known ke of crystal pickup and has changed pickup load resistor in the circuit 05 megohms to meet the pickup manu- turer's recommendations.

. The trouble that you are having ld be caused by many things but t a few general remarks on the cuit would be appropriate. The cir- t was designed for use with the dium output magnetic pickups and that reason the pickup section was igned with the necessary degree of s boost and gain. As a crystal pick- already has an inherent bass boost, s additional lift is unnecessary. Also crystal output voltage is very much her, nowhere near the same amount gain is required. We suggest as an tial test that you render inoperative separate pickup amplifier by dis- nnecting the plate load from the B- s line and feed the pickup directly o the position 2 and 3 of the switch a. If this is satisfactory it may be t this way. While we feel that this ll in all probability cure the trouble, her points which can be tried are as lows: Check the decoupling of the plus line by adding capacitance in rallel with the existing capacitors; the plus line is, of course, the most com- on source of trouble in low frequency stability problems. Check the rectifier lve for possible part failure. As re- rds the pickup load resistor, it is not usual to use a value of some 10,000 50,000 ohms to reduce output and ss response. A check should also be ade of the feedback to see that it is gative and not positive and that the ount of feedback is not excessive or ving rise to your particular trouble.

L.D. (Longwarry, Vic.) writes to ex- ess his appreciation of the series on ectronic music and the Grid Dip Os- lator. He suggests another form which is device may take in which the vari- s coils are enclosed in the instru- ent and selected by switching. Coupling the circuit to be tested is achieved means of a small coupling loop on e end of a co-axial cable.

A. Many thanks for your kind re- arks, L.D., and there appears to have en quite a considerable interest aroused the Electronic Music articles. We ve already considered a grid dip os- llator along the lines you suggest. ough so far it is little more than an ea and we have not had an oppor- nity to try it out. However, we will ep the suggestion in mind as the basis r a future project.

D.M.K. (Port Augusta, SA) inquires if we have published circuits and constructional details of high-powered PA systems, preferably of the order of 80 watts' output

A. No, D.M.K., we have never published such an instrument, as it is for special application, not usually required by the average home constructor. However, our 40-watt amplifier, to which you refer, could be pressed into service, and if the power output is insufficient, it could be duplicated and driven from a common preamplifier. Alternatively we suggest you contact a firm dealing in PA equipment, such as AWA.

R.G.D. (Joonah, Vic.) wants to know if we have ever published any designs employing the 955 valve or the VCR 97 CRO tube. Also any designs for RF power supplies for G-M counters, small models, &c.

A. We have not described any equipment using the valves you mention, though it would probably be possible to modify some of our designs to use these. The only G-M counter we described used a very effective relaxation oscillator as a power supply operating in the audio range. We have never considered the possibility of RF power supplies for models and we are doubtful whether they would have any advantages to offer. An RF power supply for a CRO was described in the "Reader Built It" page for November, 1952, and a copy of this is available through the query service.

F.P.G. (Melbourne, Vic.) wants the design of a four-valve portable set suitable for both AC and battery operation.

A. The set which would appear to be most suited to your requirements is the Multie Talkie portable described in July, 1948. A copy of this circuit is available through our 2/- query service.

P.L. (Salisbury, SA) sends us a circuit diagram of a small battery set and inquires if we can supply coil data for it.

A. The set appears to be a simple three-valve set having an RF stage, regenerative detector, and power output stage. The coils appear to be for both broadcast and short-wave bands, the broadcast section being shorted out for short-wave operation. The design of such a complete set of coils is rather outside the scope of our query service but it would be possible to combine the data for both the broadcast and short-wave coils which is contained in one of our pamphlets entitled "Coil Data For Small Receivers". The regeneration coil appears to be common to both broadcast and short-wave coils and may require careful adjustment for best results on both bands. The pamphlet is available through the post for 1/-.

L.J.P. (Concord, NSW) writes to us about the possible publication of S/W converters covering the "Ham" bands, and also the VHF bands.

A. We agree, L.J.P., with the points you make in your letter, and we hope to rectify the omissions just as soon as the pressure of work permits.

R H.S. (Vaucluse, NSW) is interested in the conversion of valve type hearing aids to transistor operation. He wonders whether R, T and H will publish any articles on the subject.

A. Hearing aids are highly specialised devices, R.H S., and therefore just a knowledge of transistors, and skill to assemble them, would not be sufficient to produce a useful device. A maladjusted hearing aid, far from giving satisfactory results, may actually do more harm than good. We are therefore rather hesitant about hearing aids of any kind. In any case, the subminiature assembly techniques would be far beyond the scope of the average home constructor.

C.J.P. (Glenroy, Vic.) sends his yearly subscription and also some queries regarding the index for last year and the printed scale for the Exposure Calculator.

A. Good intentions are always hard to fulfil in practice, so that the index has not so far been published. Staff shortages and limited space have been the main reason. However, as soon as these are overcome, we shall publish the index. Printed scales for the Exposure Calculator are still available from our files, at a cost of 2/- each. Your subscription has been forwarded to the appropriate department.

B.D.C. (Stanley, Tas.) inquires whether cases for the recent Grid Dip Oscillator are available commercially, and where.

A. As usual with all our projects, we have passed on the blueprints for the Grid Dip Oscillator to the chassis manufacturers. Supplies of these chassis should therefore be available through your usual wholesaler, on special order.

The Radio, Television and Hobbies Query Service

All queries concerning our designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

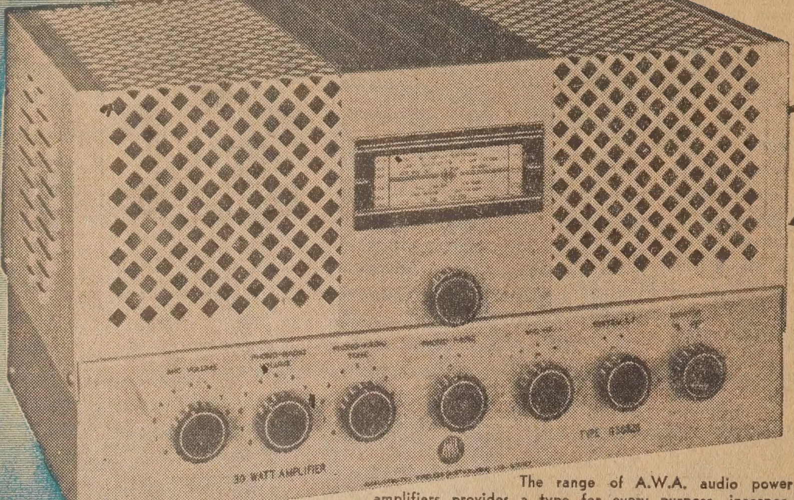
To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, RADIO, TELEVISION and HOBBIES, Box 2728C, GPO, Sydney.

Note that we do not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

AWA PUBLIC ADDRESS AMPLIFIERS

5 Watt to 70 Watt



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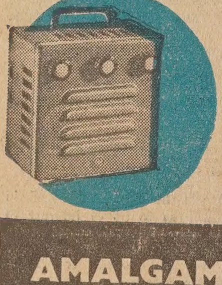
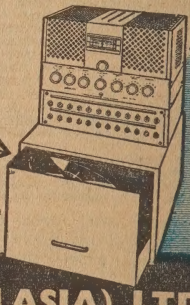
Designed and built to the same high standards of quality workmanship and performance for which the Company has established a world-wide reputation in broadcasting and communication equipment, models PA825 15 watt, PA826 30 watt and PA827 70 watt are illustrated above with radio tuner PA831 fitted. The amplifier protective cover has provision for mounting a monitor speaker.



5 watt portable amplifier type PA806 provides ample power for the needs of most indoor gatherings and many outdoor applications.



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ONVERSION TYPE DC AMPLIFIER

(Continued from Page 57)

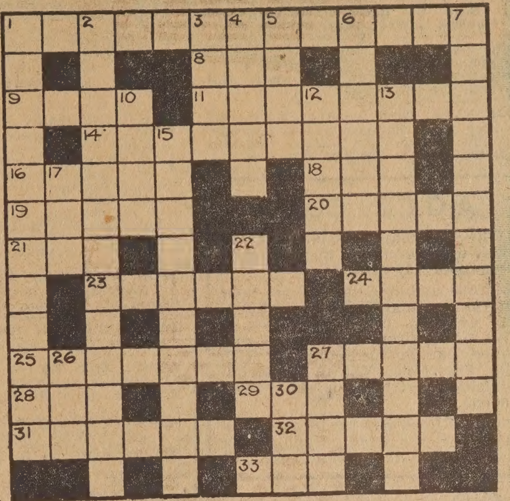
oximately to the DC voltage scheme is illustrated by Figure

ie transistor is connected in a mon - emitter, tickler - feedback of audio oscillator circuit. The ating frequency is determined fly by the inductance of transier winding L1 and the shunt citance, C1. The third winding, serves as output coupling.

ie circuit is inoperative until a signal is applied. Indicated rity of the DC INPUT terminals orrect for PNP junction tranors. The polarity must be reed for NPN junction transistors. it-contact transistors are not suit- for this circuit or application, e they will not oscillate at the low DC voltages applied to the INPUT terminals. The input DC ial is the only transistor voltage uired!

his type of converter has the antages of small size and comtness. It may be built into a ill container and mounted at the nt end of the AC amplifier. Its advantage is temperature sensiity of the transistor characteris-. However, this is compensated a degree by the emitter degenerae resistor, R, which serves to bilise the oscillator output not only iinst temperature effects but also iinst variations in individual trantor replacement units.

THE R. & H. CROSSWORD No. 18



ACROSS

1. Type of speaker.
8. Institution of Radio Engineers (Abbrev.).
9. Organs of hearing.
11. Band of frequencies.
14. Self starting motor (2 words).
16. Lake on the border of California and Nevada.
18. Meteorology (Abbrev.)
19. Degrees of speed.
20. Head dress.
21. Mineral.
23. Line pattern on a TV tube.
24. Unit of power.
25. Type of TV scanning (pl.).
27. Electrical measuring instrument.
28. Charged atom.
29. Type of square.
31. Common name given to amylum.
32. Radio tube.
33. Very damp.

DOWN

1. Electrical conduction by transfer of matter.
2. Point of connection to ground (2 words).
3. To lift.
4. English artists.
5. Ooze.
6. English politician.
7. Part of a motor (pl)
10. Foot dress.
12. Used in grooming the hair (pl.).
13. Reactive.
15. Impedance to current flow.
17. River in Switzerland.
22. Lowest.
26. Variable divider (Abbrev.).
27. Flesh.
30. Biblical woman.

Solution and further crossword next month

nswers to Correspondents

.D.G. (Cootamundra, NSW) writes to the serviceman some of his recent blems, mainly concerned with car lios. He also wants to know if one the car radios mentioned in a recent viceman article was of a certain make d model. Finally he comments on the h rate of failure of crystal cartlges in his district and wants to know we can throw any light on the cause.

A.: Many thanks for your letter, J.D.G., d we have passed it on to the servicein for possible use in his columns. He vises us that the set in question was e same make and model as you sugst. If it is any consolation it seems at you are by no means the only one ving trouble with crystal pickups. We e afraid we cannot offer much comment her than that already made by local ents. We have not heard that cold s any effect on these devices, but ere appears to be little doubt that eir main enemies are humidity and at. They can be protected from imidity by packing in silica gel and om heat by simple common sense. Hower, they are likely to encounter heat hile in transit and one firm has had to ake a practice of shipping their sets rail without the cartridges and forarding the latter by air mail. The tion of the heat is to cause the crystal dissolve in the liquid actually conined in the crystal structure. It is to hoped that the new ceramic types ay be more reliable under extreme imatic conditions. These have just ecently been announced.

J.M. (Charters Towers, Qld.) would ke us to publish a small dual-wave reeiver using parts from the miniature Xer. He says that this latter set is ot powerful enough for long distance roadcast reception.

A.: Your report on the set is so erogatory that we rather suspect that is not performing as well as it should. ou do not mention whether the reaction behaving properly, nor do you mention ie nature of the aerial and earth being used with it. Your location is a rather difficult one, from memory, and you may be expecting too much from the miniature DXer or any other small set, for that matter. A big set may be your only answer if you want big signals on the broadcast band. Short-wave reception should be as good from Charters Towers as from anywhere else, however.

G.P. (Strathfield, NSW) writes to enquire where he can buy radio-active phosphorescent paint for use on the dial of the Kloxette.

A.: Since you appear to have tried all the normal channels without success we suggest that you try some of the larger watch and clock repair shops or suppliers for same. Since the paint normally used on watches and clocks is of the type you require there should be no difficulty in obtaining it.

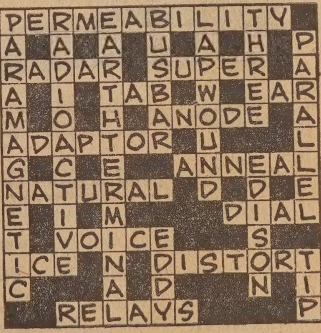
L.G. (Bondi, NSW) asks if we can forward to him details of the international short wave stations and transmission times.

A.: We are afraid that we have no such list available and we suggest that you keep a watch on the short wave notes published in the magazine each month. The main difficulty that would be encountered in publishing such a list would be in keeping up with the very frequent changes made in the schedules and transmission frequencies.

R.E.D. (Eastwood, NSW) writes to express his appreciation of the magazine and his interest in transistor devices, particularly as applied to hearing aids.

A.: Many thanks for your kind remarks, R.E.D., and we trust the magazine will continue to prove interesting. We have no immediate intention of describing the construction of a transistor hearing aid. Hearing aids are essentially a specialised device, whether they use transistors or valves, and need to be selected to suit the individual's particular degree and type of hearing loss. There is much more to it than merely designing an amplifier to make sounds louder.

Last Month's Solution



WANTED TO BUY, SELL OR EXCHANGE

Cost of Classified advertisements in this section is 2/- per line, approximately five words to a line. Closing date for November issue of Radio, Television and Hobbies is Wednesday, October 12.

FOR SALE: Complete set R & H early volumes bound, net price to **C. Tottenham, P.O. Box 108, Swan Hill, Victoria.** Freight extra.

FOR SALE: Disc. Recorder B.R.S.—R33 Play Back Standard and Microgroove with microphone. Offer wanted. **J. Nelson, 61 Berry St. N.S. XB9223.**

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The Victorian Division A.O.C.P. Class will commence on Thursday, November 17, 1955.

Morse and Regulations are held on Monday and Theory on Thursday evenings from 8 to 10 p.m. Persons desirous of being enrolled should communicate with the **Secretary, W.I.A., Victorian Division, 191 Queen St., Melbourne.**

Phone FJ6997 (from 10 a.m. to 4 p.m.), or the Class Manager on either of the above evenings.

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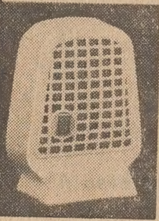

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FOR SALE: All back issues of R & H over 1000 copies in stock. Write now to **T. Weir, 73 Gibson Ave., Padstow, N.S.W.** 4/- per copy including post. Complete years 1943 to 1951 £1 per 12 copies including post. Enquiries welcome **UY8056**

FOR SALE: Records for learning. Morse Code. **K. Semmler, Box 26, Murtoa, Vic.**

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SELL: Printing, Special Offer:—100 Business or Visit Cards, 30/-; 100 Letterheads, 30/-; 200, £2. Sent anywhere by mail. Do it now! **W. Hiley, 841 George St., Sydney.**

SELL: "GILCO" Convertor, 32V D.C. to 240V A.C. 120W. 50 Cycles 0.8 P.F. £10. **C. Stephen, P.O. Parkes, N.S.W.**

SELL: Philips 8 Watt Amplifier, as new. Price £18. **D. J. Danhay, 12 Premier Ave., Mitcham, Victoria.**

SELL: Over 200 copies radio magazines, transformers, condensers, resistors, speaker, headphones, meter, valves. The lot, to clear, £6. **H. Walker, 66 Johnston Crescent, Lane Cove, Sydney. JB2981.**

SELL: 2 Garrard Record Players. R.C. 65 Ghawler £5, Type T. 3 Speed Current Model £8. **18 The Ridge, Canterbury, Victoria. WF8914.**

SELL: R & H back issues from July 1953 to November 1954. What offers. **D. Dennis, Coolangatta, Queensland.**

SELL: No. 11. L.P. & H.P. Genemotors. 12 Volt Battery Charger. **W. Miller, 7 Lavender St., North Sydney.**

SELL: Rola G12 Speakers. New fields, cones. £4 each or offers. **A. Fuss, 34 Alkoomie St., Beverly Hills.**

SELL: Two quality gramophone amplifiers, two microgroove players and two 12in speakers. Large collection classical records, 50 microgroove. **89 Eton Rd., Lindfield, N.S.W. (JM1739).**

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Supplies. Grey enamel steel cabinet 79in
19in x 28in. First class componen
Original circuit diagram. Missing: Mete
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SELL: Speaker Cabinet, bass refle
polished. £17. **BW3315. Sydney.**

SELL: Technical Booksellers, 56 Hunt
St., Sydney. For Radio Televisi
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price and particulars to **G. J. Pre**
tice, 26A Muir Ave., Kerang, Vic.

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D. MacMillan, 28 Vernon St., Ces
nock, N.S.W.

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with disc recorder. Please write
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WANTED: Radio Service Manual Vol.
in good order. Write to **A. Ginte**
16 Chyrsler Rd., Croydon. S.A.

WANTED: AR7 Coil Band "C" VK4M
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pay good price. Reply **"Radio" Box**
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GP32

£2'12'6

Provides a good standard of reproduction with normal equipment at a reasonable price. Element incorporates new high-permeability sintered bi-metal magnet. Output voltage — ½ volt at 1000 cps.

Available from leading radio houses everywhere